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(J. A. BERLY'S).

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ELECTRICITY IN MINES.

SOME interesting correspondence has recently taken place in our columns in regard to the status of the colliery electrician. Two distinct points of view seem to prevail on this subject.

On the one hand are the people who say that the electrical engineer at a colliery will eventually come to have the entire charge of the whole machinery, and become as important as the mechanical engineer. On the other hand, there are the people who consider that the mechanical engineer is, and must always remain, the important man, however little electrical knowledge he possesses, and that the electrician must always occupy a subordinate position.

Both of these generalisations fail to take note of the personal factor and the local conditions. In large pits where the colliery electrician is a properly trained mechanical engineer, and where the electrical installation is an important one, his position will inevitably tend to become one of considerable importance. It may be that with the increasing use of electricity in mines, the electrical engineer will ultimately become almost as important as the mechanical engineer, but it will be many years before this comes about, and even then, it will only result if the electrician is also a mechanical engineer.

These reflections are induced by perusing the new code of rules issued by the Home Office for the use of electricity in mines. The former code, issued in 1905, required bringing up to date, and the present code marks a great advance in clearness of definition of the maintenance and supervision to be required in future in pits where electricity is installed. The important thing to note, and the one which is emphasised both in the report of the Committee and in the explanatory memorandum accompanying it, is that nearly all the faults in the past have arisen from one or other of two causes :—

1. Faulty mechanical construction and design of the apparatus ; and

2. Insufficient supervision and maintenance.

The present-day tendency towards improving the mechanical design of electrical apparatus is not, of course, confined to apparatus for use in mines, but it is particularly important in this case owing to the very much rougher conditions under which such apparatus has to work, conditions which have not always been appreciated by the makers of electrical apparatus.

While the new rules deal with a number of other important points, for which readers must refer to the document itself, the main features which stand out are the need for a higher standard of workmanship and better mechanical design in apparatus intended for use underground, and for improved supervision.

In the early days mechanical engineers sneered at electrical apparatus as being constructed of "shellac, rubber and string." Great though the improvements are which have

been made in the direction of removing this fault, much still remains to be done in the direction of improving the mechanical details of electrical switchgear, cables and other apparatus. Important as is this point above ground, it is infinitely more important below ground. Apparatus which will work for years, more or less without trouble, in sub-stations and generating stations—that is, in places where it is inspected and where the staff always possess a certain amount of technical knowledge—not only gives endless trouble below ground, and runs up the cost of repairs, but is liable to lead to very serious accidents. It must be remembered that the results of an accident below ground may be much worse than those of one above ground; for while an accident from shock usually concerns one or two persons at the most, an explosion in a mine may affect hundreds. It is on this account that the Committee lays stress on the avoidance of open sparking and its prevention; in fact, the principal objects aimed at in the new rules may be said to be primarily the prevention of open sparking; and, secondly, a reduction in the risk of shock. Both of these dangers can be almost entirely prevented if sufficient care be given to the kind of apparatus put in the mine, the way it is put in, and the way it is looked after. Some suggestions for the assistance of mine managers and others are set forth in a very useful and practical memorandum accompanying the rules. Many of the points there dealt with do not lend themselves readily to definite rules, and some of them may appear to highly educated young colliery electricians as superfluous. But trite though they may appear in some cases, they none the less deal with just the kind of things that are most neglected in mine work. Such points as the best way of making an earth, the design of plugs for portable apparatus, and the need for seeing that armoured cables are sufficiently protected, are the very points upon which the colliery manager will be glad to have the practical experience of the Committee at his disposal.

The net result of the enforcement of this new and improved code of rules should not be, as was at one time feared, to hinder the development of the use of electricity in mines, or even to put coal owners to heavy increased expenditure; and in this direction the report differs from some of the departmental regulations which have been issued. In fact, it will not be too much to say that in the long run it will probably lead to an actual saving in cost to the coal owners, for it will tend to stamp out the use of unsuitable apparatus underground, and will raise the standard of electrical work and electrical workers connected with collieries. Moreover, it should help to extend considerably the adoption of electric power, if only from the fact that the use of electricity in mines, placed on trial, has been amply vindicated by the evidence brought before the Committee. To quote the report: "Experience has shown that the proper use of electricity cannot be regarded as inherently unsafe, that it possesses some characteristics which are of greater advantage in underground conditions." Only 1½ per cent. of the fatal accidents in mines are attributed to electricity, and the use of electric power in pits is increasing much more rapidly than the number of accidents.

Electric Street Lighting—Carte Blanche.

Amongst the few daily papers which make pleasant reading for the electrical engineer, the *Sydney Morning Herald* must surely take a very high place. For in its issue which appeared on December 29th last we read: "There is little doubt that the gas lamp must go, whether he belongs to the out-of-date fraternity that flickers mournfully in the gloom, or whether he lords it over us in dazzling and all-too-radiant mantle. He belongs characteristically to the nineteenth century, and, in spite of all improvements, he still wears a mid-Victorian air."

These remarks occur in the course of an editorial on "Disappearing Gas Lamps," and are based on the remarkable extension of electric lighting in the streets of Sydney and its suburbs. Even London's record of 14,000 to 15,000 street lamps turned over to electric lighting within the last year or two pales before the widespread movement in favour of electricity now taking place in Sydney, but then it is possible that the gas-advertising campaign, in tabloid form, which has become such a feature of the London dailies' news columns, may not have penetrated to the Antipodes—at any rate, the *Sydney Morning Herald* has not found it necessary to distort a wholesale turnover of street lighting to electricity into a victory for gas.

How far-reaching the turnover to electricity has been will be understood when it is known that preparations are in full swing to complete the lighting of the Sydney streets entirely by electricity—the outcome of the City Council's resolution mentioned on our page 97.

But this is not all, for both the City Council and the Balmain Electric Lighting Co. are energetically pushing electric street lighting in the suburbs. Last year the Balmain Council discontinued the use of gas for street lighting in favour of electricity, and both the Newtown and Annandale Councils followed suit on January 1st last; the Glebe, North Botany, St. Peter's and Erskineville Councils are understood to have given the necessary notice to discontinue gas lighting in the streets, and the Waterloo and Alexandria Councils have come to an agreement with the Sydney Council to adopt electrical street lighting, and to give similar notice.

The Botany Council was seeking the ratepayers' approval last month for the substitution of electricity for gas, and there is a general feeling that the Petersham and Leichardt Councils will follow the example of the adjoining boroughs and give the customary notice to the gas people.

A movement is also on foot in North Sydney and the suburbs on the northern side of the harbour to combine and provide an electricity supply for street lighting and other purposes, while a largely extended use of electricity is shown by the Government, the lighting of the Domain electrically, at a cost of over £700 per annum, being an example. The metal-filament lamp has, of course, done yeoman service in the matter of street lighting in this country, but such a wholesale slaughter of gas lamps in one locality as that mentioned above is surely unprecedented.

The Hulton Colliery Disaster.

The result of the inquest on the victims of the explosion at the Pretoria Pit must be regarded as highly satisfactory to electrical men, as the "electric spark" was completely exonerated. The jury ascribed the accident in the first instance to a defective or overheated safety lamp, and found no evidence of neglect of any statutory obligations on the part of the mine-owners. The evidence of two miners, to the effect that they had seen sparking at the gate-end switch, received no support from careful examination of the switch and the amount of oil it contained immediately after the disaster, and Mr. Nelson, H.M. Inspector of Mines, cited an instance where similar sparking from a motor had been reported, but on close investigation was proved to be not sparking at all, but the glimmer of lamps seen beneath the door of a haulage-room.

Dr. Thornton testified to the excellence of the plant, and stated that no better choice could have been made than the paper-insulated and armoured cables, which withstood the heaviest falls in the workings.

Yet, in the face of independent expert evidence, the miners' representatives reiterated their opinion that the explosion arose from sparking at the switch, although they could produce no credible evidence whatever in favour of their hypothesis, which appears to have been based purely upon prejudice. We cordially agree that faulty electrical apparatus ought not to be permitted to remain or to be put in any fiery pit; but when the apparatus is sound and well designed, and there is no valid reason to regard it as dangerous, it is mere trifling to recite the same formula like a parrot.

Prejudice, especially amongst the ignorant, dies hard; and steps should be taken to convey to the miners everywhere at least such elementary ideas of electrical phenomena as will enable them to realise their nature and capabilities. So long as electricity remains a mystery to them, it will remain the object of their suspicion and aversion.

Preparing for the Electrical Exhibition.

There are some seven months to elapse before the opening of the Electrical Exhibition at Olympia. These will be full months, for, in addition to increased general business, they will include the Coronation, the M.E.A. meeting, the B.A. meeting, the Tramway Congress, the Turin Exhibition, and the general holiday season. Therefore it will be as well to get forward without any delay with all the necessary preparations for taking London by storm on September 23rd with the opening of what we expect to be our greatest Electrical Exhibition. Space-letting and general arrangements are proceeding apace, and the co-operation of those whose assistance is of value in compelling success is assured. Last week a gathering of representatives of electricity supply companies and municipal corporations operating in the London district, with several gentlemen representing the National Telephone Company, the L.C.C. Tramways, and other public departments, sat in the capacity of an Advisory Committee to consider what were the measures—supplementary to the anticipated excellent displays of individual manufacturers—most likely to draw the present and prospective user of electricity from far and near, and how best the holding of the Exhibition could be brought home promptly, and with emphasis, to buyers in Colonial and foreign countries.

Concerning the popularising question, the Committee has plenty of practical experience to guide it, for we have had so many successful Exhibitions in the big centres that there ought to be no difficulty in finding out what have been the greatest "catches." Maybe some of these features would not appeal so forcibly in London, where no one particular industry predominates, but where we have a great variety of industries and bartering in all classes of goods. The Committee in the course of its deliberations considered such attractive lines as X-rays, wireless telegraphy, the use of high-tension currents in agriculture, electric cooking (allowing the public to do their own tea and toast is suggested!), electrical advertising signs, a telephone exchange demonstrating the complexity and diversity of its operations, the uses of electricity by the Admiralty, a model laundry at work, electrical furnaces, electro-medical apparatus demonstrations, and a conference of doctors interested therein, with addresses on the beneficial uses of electricity when properly applied for relieving us from the ills to which all flesh is heir. A meeting of electrical men called together by the Institution of Electrical Engineers was a bold suggestion which will probably be considered in the right quarter, and one would hope might receive official approval. In a number of exhibitions the "Model Electric Home" has made a strong appeal to the general fancy. Probably many of our readers will be able to advance useful suggestions of a dozen or two other ways in which the public shall be attracted, the general electrical trader's interest won, the engineer and architect, the councillor and shareholder, the mansion equipper and the cottage-dweller, all be made to feel it imperative to see the latest advances in electrical applications. No doubt any original ideas will be welcomed if submitted in good time. If we can only get the people to come and see, and having seen, depart so impressed that all gas and other fictions shall not cause them to forget or to be misled again, there is bound to be a good outcome of the efforts of manufacturers, electricity suppliers, and everybody who desires an added impetus to be given to everything electrical.

All that ingenuity and excellence of organisation may do, however, will not be fully effective unless we make it known everywhere that such a display is coming. Who is to do this? And how? Everybody interested in the sale of electricity and of electrical manufactures ought to take a hand in it. Electricity suppliers will be able to adopt their own useful measures for disposing of tickets; every electrical contractor's and ironmonger's window within a reasonable distance of London ought gaily to announce the fact, free tickets being the reward for so doing. The interest of the Press, so given to straying along the broad path that leadeth to gas, ought somehow to be secured. Hoardings, newspapers, electric light bills, tramcars and every other opportunity in reason, and within reach of the Exhibition exchequer, should be made use of to proclaim the event. A grand success, with record attendances, booming electricity for all we are worth—that is of more importance than the Exhibition Committee being able to show a big profit on the turnover.

The other matter before the Advisory Committee—that of making the Exhibition known to Colonial and foreign buyers—is as important from the electrical trade point of view as is that of popularising the show among the people at Home. Readers of the Electrical Review abroad who, we believe, scan their electrical journals more searchingly than do some of our friends close at hand, have already been made aware of the Exhibition; but we will take advantage of the present opportunity to urge it specially upon their attention, in the hope that they will be able to time their visit to the Mother Country so that it shall include, at any rate part of the period extending from September 23rd to October 21st. It is hoped that the co-operation of the Board of Trade and Chambers of Commerce may also be obtained in carrying the information abroad. The foreign buyer of electrical goods will not, of course, be drawn by our popularising efforts, the exhibits of up-to-date electrical manufactures and practice are what he will be interested in; so the Exhibition will have to reasonably combine both the popular and the technical if we are going to boost up general electricity supply business at home and increase our turnover abroad.

Holborn and Chelsea Street Lighting.

Elsewhere in this issue we refer to the peculiarly prejudiced attitude of the Holborn Highways Committee in the matter of street lighting. This attitude is evidently shared by the Chelsea Council also. In the former case, the Committee, in the face of an electric lighting tender offering nearly 25 per cent. greater illumination per lamp, and a saving in the lighting bill of over £900 per annum, went out of its way to recommend the continuance of gas lighting for a period of 10 years. Fortunately for the Holborn ratepayers the Council refused to be a party to such an inequitable arrangement, and it is possible that the Committee may be brought to see the error of its ways before the matter comes up again.

In the case of Chelsea, the gas company offered to cancel an existing contract, provided the Borough Council agreed to enter into a new contract for a term of years.

The Chelsea Electricity Co. incidentally heard of this proposal, asked, and were granted, permission to tender *if they desired*, and within 12 days succeeded in submitting a tender for the whole of the street lighting in Chelsea, at a price which, it subsequently transpired, was lower than that submitted by the gas company. Despite this, the Council, without further discussing the electricity tender with the Chelsea company, entered into a seven-year contract for gas lighting.

Since a few electric lamps were replaced by gas lamps in Westminster, our gas friends have never ceased to boast that electricity was beaten on price. We should be interested to know their explanation of the Holborn Committee's preference and the Chelsea Council's action.

Unfortunately the average ratepayer neither knows nor cares what his municipal representative may do—Council meetings and pic-nics run together in his mind—but it is somewhat surprising that while the L.G.B. finds it necessary to safeguard the ratepayers' farthings, when it deals with electric street lighting matters, it appears to be nobody's business to check the reckless expenditure of the ratepayers' money on street gas lighting.

THE "SINGING SPARK" SYSTEM OF WIRELESS TELEGRAPHY.

[BY OUR BERLIN CORRESPONDENT.]

In December, 1906, Prof. Max Wien published the first account of a phenomenon on which the new method of wireless telegraphy has been based. In order better to illustrate this phenomenon, we propose briefly to recall the general behaviour of two circuits, one of which (viz., the exciter circuit) comprises a spark-gap, whereas the other circuit is tuned electrically and closely coupled to the former. From its initial maximum amplitude, the oscillation in the exciter circuit rapidly decreases in intensity, so that, after a few oscillations, its energy is communicated to the second circuit and the primary energy becomes exhausted. There will then take place a reflux of energy from the secondary to the primary, until the latter once more contains the whole of the remaining energy, and this cycle is repeated several times. It might be supposed that the spark would be quenched at the very moment the energy had, for the first time, left Circuit 1. However, the course of events is, in reality, quite different, the spark being maintained throughout the fluctuations of energy until the oscillation of Circuit 2 has vanished almost entirely. The resistance of a spark-gap is known to rise as the current intensity decreases, and as the current amplitude of the exciter at the end of the first stage falls at a certain moment to zero, the resistance of the spark-gap should then be very high. But this is not found to be the case, and owing, it seems, to the accumulation of heat, the increase in resistance lags behind the reduction in current intensity, so that at the critical moment its maximum value is not yet attained. The secondary circuit then exerts an inductive effect on the primary, and the potential difference produced at the terminals of the spark-gap, owing to the still moderate resistance, results in the production of further sparks. The spark discharges, owing to this reflux of energy, are thus never discontinued, and the resonance curve of such a coupled system always yields, in the place of the fundamental vibration of the tuned system, two new frequencies different from the former, viz., what are called two coupled waves. Prof. Wien's experiment was as follows :—

While examining, by means of a resonance circuit, two such vibratory circuits closely coupled together, of which the primary one contained a very short spark-gap, the Professor found, instead of the usual two coupling waves, a system of three waves. According to him, this phenomenon was due to the resistance of the very short spark-gap increasing very rapidly, so that, the vibrations in Circuit 1 disappearing rapidly, only those of Circuit 2 were left. The latter then could go on vibrating, as an uncoupled individual system with its own frequency of vibration and damping.

Count Arco, of the German Wireless Telegraph Co., took up this experiment with a view to obtaining by its means nearly undamped vibrations, and in conjunction with Mr. Rendahl, after nearly two years' work, succeeded in working out the system of wireless telegraphy, termed the "singing-spark" method, of which a short description follows.

The sender consists of an exciter circuit, containing the "quenched spark-gap," as Wien's arrangement is called. To the exciter circuit is coupled, inductively or otherwise, the tuned antenna system, the coupling between the two circuits being on the one hand so close as to cause the exciter energy to pass as quickly as possible; and, on the other hand, so loose as to damp any waves outside of the secondary main vibration. Coupling efficiencies of 15 per cent. to 20 per cent. are obtained in most cases, the damping of the wave emission being, in the case of slowly-radiating umbrella or T-antennas, about ·08 to ·1 if the antenna vibrates with its fundamental wave, and only ·05 to ·03 if the wave be extended to three or four times the fundamental vibration. The condition of the spark-gap does not exert any influence on the frequency of the second circuit, and accordingly it does not need to be regulated The period is, on the contrary, absolutely constant, so that resonance can be fully utilised.

In order to control the wave length, either the capacity of condensers or the inductance of inductive coils—or both factors—can be altered, the most convenient method being the variation of inductive coils, as used in wireless telegraphy in the shape of "variometers." While the latter had previously only been designed for low pressures and current intensities, so as to be suitable only for the receiver, the

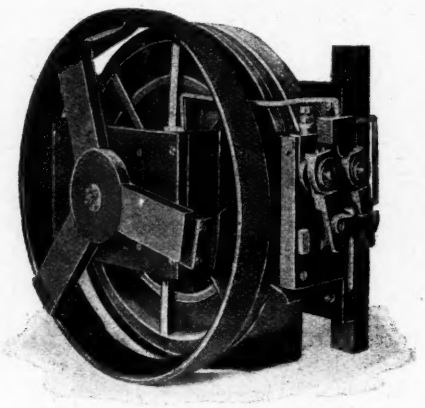


Fig 1.—Sending Variometer

German Wireless Telegraph Co. succeeded in designing them for receiving very considerable amounts of energy, so that they could be employed in connection with the sender. Fig. 1 represents such a sending variometer, intended for the exciter circuit or the antenna of a transmitting station. It consists of a fixed disk and a rotary disk, both of which are wound with wire, the windings being arranged either in series or in parallel. When the disks are adjusted so that the fields of the four coils are added, the self-induction will reach a maximum, whereas, in the event of the fields being in opposition, the self-induction is a minimum. The intermediary positions then yield any value comprised between these extremes. Variations in the ratio of 1 : 16 can thus be obtained by a complete rotation and a single change from parallel to series connection with the variometer.

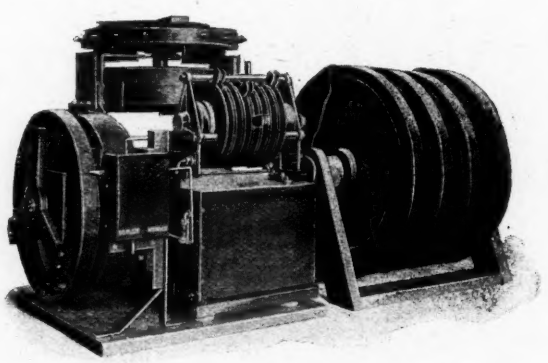


Fig. 2.—Complete 2-kw. Sender.

In the case of a constant primary capacity, the variometer thus allows the wave to be altered from 1 to 4—*e.g.*, from 500 to 2,000 metres; and more complicated constructions even allow of a continuous variation between 1 and 5. In order further to increase the range of waves, either the variometers are changed or the capacity is altered by steps.

As regards the feeding current of the exciter, a maximum number of impulses being desirable, alternating currents of about 500 to 2,000 cycles per second were adopted, giving a succession of 500 to 2,000 spark impulses per second. The regularity of this spark generation can be made so great as to convert the noise of the spark into a real musical sound. The purity of the latter plays an essential part in connection with the utilisation of energy and freedom from disturbance in the receiving apparatus.

The alternator current is transformed with a view to charging the exciter capacity to from 4,000 to 70,000 volts,

according to the dimensions of the station. This transformation is effected in large stations by means of an induction coil, and in smaller stations by a transformer.

The high-frequency apparatus of the exciter circuit will now be described. The main point in this connection was the design of the quenched spark-gap itself, in which connection many difficulties had to be overcome. In order to make the succession of sparks quite regular, the electrodes were given the shape of rings (fig. 2), the active surfaces being planed. In order to keep the electrodes at very short distances apart, mica was inserted at the circumference. By distributing the total energy over several spark-gaps, the experimenters were able to convert any amount of energy into electric vibrations. Copper and silver metals of great heat conductivity were chosen as electrode materials. The large number of individual spark-gaps, so far from complicating operations, allows of a very simple regulation of the transmitted energy.

In contrast to the trouble caused by the spark-gap, the design of the capacity did not offer any difficulty. As, owing to the rapid quenching of the primary circuit, any excessive care in regard to slight losses was quite superfluous, the experimenters were able to substitute for the Leyden jar the far less efficient paper condenser, of which a sufficient number were connected up in series.

In connection with both the capacity and the third element of the exciter circuit, the inductive coil, maximum safety and minimum volume were the most important points to be considered. The rapid quenching of the exciter circuit ensured an economy previously unknown in the production of high-frequency oscillations, the efficiency coming very near 100 per cent.

Far more difficult was the design of the secondary circuit, as the energy in the latter is kept up for a very long time, while its damping determines the damping of the electric

Fig. 3.—Wave Meter, Complete.

wave given out. The Braun arrangement, in conjunction with slowly radiating slightly damped antennæ, was provisionally adopted, in spite of many drawbacks. Very fine subdivided copper wire of 0·07 mm. diameter was used in winding the secondary circuit. Owing to the very high current intensities in the antenna, very low resistances had to be designed. In the case of the smallest type, the 2-KW. station, the antenna coils were made up of 480 individual conductors connected up in parallel, whereas the 8-KW. station comprises upwards of 3,000 wires, each of which has exactly the same resistance and self-induction.

In order to allow the wave length of the antenna to be readily varied, one section of these coils has been designed with continuously variable self-induction, while the remainder is variable by steps. Whereas the old exciter method at most allowed of an extension of about 1·5 times the fundamental vibration, this arrangement thus allows, by a suitable combination of both parts, of a very extended wave variation. Fig. 2 represents a set of antenna coils with variometer.

At the receiving station the detector consists of a contact between a thin graphite point and a plate of lead sulphide or iron peroxide (mostly the latter), which contact has a resistance of several thousand ohms. Such detectors work as current rectifiers, and, without any auxiliary battery, transform alternating currents into waning trains of pulsating continuous current. 1,000 such wave trains per second, given out from the musical sender, are received as 1,000 direct-current trains, and, provided the impulses be of sufficient regularity, cause a membrane to give out a musical sound. In order to produce a given sound intensity, a smaller current amplitude in the telephone suffices than in the case of the ordinary irregular impulses perceived as noises.

The musical sound of the sparks imparts to each sender, in addition to its own wave-length and damping, another characteristic. Musically pure sounds are known to be perceptible, even if very feeble, and accordingly allow telegraph operation to be carried on even during the most violent atmospheric disturbances. The operator thus can ascertain

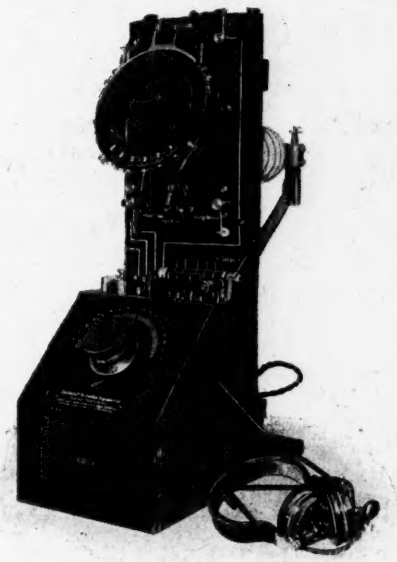


Fig. 4.—Acoustical Receiver for all Wave-Lengths.

by the pitch of the sound which station a given wave train comes from. Owing to the large scale of sounds embraced by the ear and the telephone, a very wide interval of variation (from about 200 to 2,000) is thus obtained by very simple means. By means of a resonance relay, the selectivity, as well as the sensitiveness of the arrangement, is increased considerably. The apparatus can also be designed for Morse signals, which are used whenever the subjective method fails.

The Morse receiver is actuated by a resonance relay and ensures a mechanical accumulation of undamped sender impulses. It may be said to be the first graphical receiver free from disturbance which has so far been produced in wireless telegraphy, as well as the first graphical receiver which can be used over about the same range of distances as the acoustic receiver.

The smallest type of apparatus, which requires a primary power of 1·5 KW., in the case of 20 metres antenna height ensures wireless communication to 200 km., and with an antenna of 35 metres, to 600 km. distance. The 8-KW. apparatus, with an antenna 60 metres high, has a guaranteed range of 2,500—3,000 km., and that of 20 KW., with 85 metres antenna height, a range of 3,500—4,500 km. over a level country, or the sea. The 2-KW. station can be mounted as a portable land station in a military vehicle.

Wallasey Tramways.—Another section of the tramways, completing the new route from Seacombe to Wallasey and New Brighton, *via* Poulton, was opened on Tuesday, February 7th, after inspection by Col. Von Donop, R.E., on behalf of the B. of T. One portion of this section was opened in July last, and by the completion of this track, which joins up the Warren Drive route after passing through Wallasey village, there are now three alternative routes through the borough from the Birkenhead side to New Brighton. The track construction was carried out by the Corporation, under the direction of the borough surveyor and engineer.

D

ELECTRIC GENERATORS AND WINDMILLS.

By RANKIN KENNEDY.

The windmill might be employed to a larger extent for small installations of power and lighting plant, if it were better understood that many of its old-time disabilities have to a considerable extent been overcome by progress made, not only in windmill construction, but also in generators of electricity better adapted to the variable driving of the windmill.

Wind power for electrical generators on a large scale has recently been discussed, but it has not been shown how the variations in the power, which are very frequent, and also between wide limits, are to be met. Storage of the power is an absolute necessity. It is difficult to say whether electrical storage would suffice for the rapid storage of very great powers, and at the same time be capable of slow storage when the power was small.

An elaborate system using a large number of windmills and dynamos, in conjunction with a storage battery, has been proposed, in which, by series-parallel connections, the electromotive force can be maintained within reasonable limits, while the current varies as the power. Even if this scheme were successfully put into practice, there would be periods during which the plant would be idle for want of wind.

The time during which the average current could be counted upon, taken all the year round, would be a small fraction of the whole year's working. And to compensate for the idle times the average current must be large; in other words, the load factor would be very small, considering the capabilities of the plant.

As to the site for a wind-power plant, no doubt the sea cliff's top is the best situation, where advantage can be taken of all the wind that blows.

And further, instead of electrical storage, a water storage system could in such a situation be employed, the windmills pumping the water up from the sea, to be afterwards used in turbines driving dynamos.

This hydraulic scheme, however, runs up against a difficulty nearly always met with in water-power propositions, namely, the land question. The storage of power by water requires large reservoirs, and these, covering some acres of land, require considerable outlay in the initial engineering stages and are expensive to construct. But the maintenance afterwards is small and labour next to nothing. On a well-chosen site, and with land available for storage, this hydraulic system is feasible for large installations.

As to the dimensions of the required reservoir for water storage, if H is the fall available for the turbines in feet, A the area of the reservoir in square feet, and h the depth of the reservoir in feet, the energy stored is equal to $64 \times A \times H \times h$ in ft.-lb., and about $A\,h\,H \div 31{,}000$ in H.P.-hours, from which it will be found that, on a fall of, say, 200 ft., and with an average depth of water in a reservoir of, say, 20 ft., the average required for, say, 10,000 H.P.-hours storage is considerable—over 16 acres.

With electrical storage the dynamos and their driving gear would be large, in order to take advantage of the most powerful winds; but with the hydraulic storage the dynamos would be much smaller, supplying direct at constant speed.

For small installations, unless some natural reservoir or natural feature of the country made a reservoir easily and cheaply formed for water storage, electrical storage would be preferable, coupled with some one of the dynamo-electric machines which have been designed for train lighting or motor-car lighting, driven at variable speeds; such dynamos are now available, giving fairly good results over a considerable range of varying speeds. An automatic battery cut-in and cut-out switch would, of course, be necessary.

The cells of the battery must be large, so that they may take the largest charging current on a high wind. The resistance of the whole circuit being as low as possible, the increasing current as the speed rises tends itself to regulate the speed by holding back the windmill.

As for the windmills, these are now made more strictly upon turbine principles; they are, in fact, drowned turbines without guide blades. Some four or five years ago the Royal Agricultural Society of Great Britain made some interesting tests on windmills in competition. They were employed in pumping water over a period of six months. The windmills were all in one field, and all pumped water to the same height, and the quantity was carefully recorded. The prize was awarded to the windmill which did the most work in the six months' running—a fair enough test, for all got the same winds.

A Canadian windmill obtained first prize; it was 16 ft. diameter, and had only 18 sails. The water was lifted 200 ft. The Canadian wheel lifted 80,000 gallons, equal to 160,000,000 ft.-lb. of work in six months. The horse-power-hours in this amount of work = 81. Perhaps this result, better than anything else, will give an idea of what to expect from a 16-ft. windmill. The period of the year covered was from the end of spring to the beginning of winter.

Probably, in most cases, no more than 200-H.P.-hours per annum can be counted upon at the very outside from a good wheel of this size. Most of the wheels to be seen in the country would not do half that work.

The late Prof. Blyth, of Glasgow Technical College, made a hobby of windmills for electrical power driving, and invented a windmill which gave very good results, with a dynamo designed by the author. Practically, the windmill was an enlarged Robinson's wind anemometer, which consists of four cups on radial arms. Prof. Blyth's machine had the great advantage that it did not race in a high wind, being to some extent self-regulating. We cannot all follow the example of the Royal Agricultural Society in making a six months' test to find the work to be expected from a windmill per annum, or per half-year, but from what was seen of the Blyth results, his wheel would probably have made a good showing on such a test.

Considering the price of a H.P.-hour, produced by other means, such as a gas or oil engine, 200 H.P.-hours per annum is not a large quantity; on the other hand, fuel costs nothing, and oiling, attendance, and repairs, are very low with a windmill, while small oil engines cost a good deal more to run them than the mere cost of fuel. In most cases where a windmill would be used, only an oil engine could compete with it.

A wheel on Prof. Blyth's principle, built to give about 500 H.P.-hours per annum, or more, would be found to constitute a fairly satisfactory prime mover for a small installation. This combined with a constant-current dynamo, and a storage battery of ample capacity, would form a safe combination to be left in unskilled hands.

WORKS COSTS.

By CHARLES C. GARRARD, M.I.E.E.

Introduction.—It is somewhat remarkable that in spite of the not inconsiderable amount of attention that the subject has received in the technical Press and elsewhere, wide differences exist in the methods of works cost keeping adopted by manufacturers. It must be admitted that neglect of this branch of works organisation has not always been attended with the disaster it deserves, and that some concerns which have excellent systems of cost keeping in vogue have lived for years chiefly upon their hopes for the future, while others have managed to pay satisfactory dividends while keeping their books in a similar manner to a small retail grocer or provision dealer. To argue from this that accurate works cost keeping is not necessary, would be wrong, however. The concern which does well in spite of bad cost keeping is not nearly in such a strong position as if its records were kept in a proper manner, and is far more subject to sudden changes in prosperity, due, for example, to a change of managership, or removal of certain personal influences, than it would be otherwise.

Definition.—It will be as well first of all to define clearly what is meant by the term "works cost." There exists sometimes a certain confusion of thought in this matter. By works cost is meant the *actual cost* to the works to produce a certain article. This cost must, by the nature of things,

be, to a certain extent, a variable quantity. Thus the works cost of an article will be greater if the works are slack, than if the works are running full time, although exactly the same amounts of material and labour may be expended in both cases. The variation would be caused by increase in the proportion of standing, or establishment charges.

In the same way overtime or night shift work will vary the works cost, although in these cases the matter is complicated by an alteration in the amount paid for labour. In these latter two cases it is possible for the saving effected in the proportion of standing charges, due to the increase of output, to balance the extra cost of labour. The point to bear in mind is, however, that for every article manufactured at any particular time a definite total, or works cost, is incurred which is just as definite and fixed as the amount paid in rates and taxes. It is the duty of the accountant's department to discover this works cost for everything manufactured. In some cases the term "works cost" is used wrongly to designate a figure obtained by adding together the amounts paid in material and labour, plus a certain arbitrarily chosen percentage. In such cases it is said that by varying the percentage, any works cost can be arrived at that may be desired to suit the exigencies of the case. The use of the term "works cost" in such a connection, however, is a misnomer, as it is no more possible to alter the works cost by juggling with figures than it is to reduce the rent paid by similar means. It may not be so easy to determine what the works cost is, as it is to know what rent is paid, but one cost is just as definite as the other, and the object of the cost-keeping system should be to determine it with as great an accuracy as possible.

Advantages of Accurate Cost Keeping.—The chief advantage of accurate cost-keeping is, undoubtedly, the machinery it affords for efficient works management.

The main object, after all, which the works manager has in view is to show a satisfactory credit balance to his profit and loss account at the end of the year. The organisation of the works records, therefore, should be such that the immediate effect of the running of the works will be shown on the profit and loss account. The various accounts should serve as index figures of the efficiency, or non-efficiency, of the works, and should be so recorded that a bird's eye view can be obtained of the organisation of the various departments both as regards their relation one with another, and as regards their variation with time. By these means the manager is enabled, without burdening his mind with a large mass of detail, to put his finger at once on anything going wrong, and is, moreover, enabled to arrive at a surer judgment of any state of affairs, as nothing is more likely to lead to mistaken decisions than consideration of the matters adjudicated upon by themselves and not in relation to what has gone before.

The lot of the manager who has organised his works on these lines compared with the one who keeps his books on the "grocer's shop" principle is very enviable. The latter has always got the uncomfortable feeling that if he himself be not on the spot, things may go wrong and he will be at least, until the end of the year, none the wiser. Even a week before the end of the year he is wondering whether he is coming out with a large profit or a large loss. Even when he has determined his profit or loss he has but a very hazy idea as to where it has been made, and for all he knows, he may go on neglecting that branch of his business that pays and develop that part which is run at a loss.

On the other hand, accurate cost keeping provides an exact and automatic reflex of the condition of every part of the organisation.

By being continually passed in review before the manager, it is not possible for any slackness to escape his notice. This has a very wholesome effect upon all sub-managers and foremen, who know that whatever they do is recorded in the books of the accountant's department, and that the immediate effect of their efforts upon the financial results of the firm is shown.

The gist of these remarks is that every job undertaken by the works should show in the official books of the firm the true profit or loss on the transaction, that is to say, the difference between the works cost and the selling price. The works cost is the sum of three items, viz., material, labour, and the establishment charge, the third item being the actual amount which it costs the concern to spend the first two amounts on material and labour, under the conditions under which the particular job is carried out.

Material Cost.—The determination of the material cost is simply a question of stores book-keeping, but, strange as it may appear, the greatest variations exist in the practice of different firms in this matter. Some concerns do not keep a regular stores account at all; material which comes in is booked straight away from the invoice to the manufacturing account, and it is only possible to say what is the value of the material in the stores at the time of stock-taking. With this system, cost keeping, as adumbrated in this article, is impossible. What would be said of a bank whose books did not show, from day to day, the amount of bullion in its vaults? In a similar manner the stores accounts should show, if not from week to week, then at least from month to month, the total value in pounds, shillings and pence of its stock. All material which comes into the place should be, in the first instance, debited to stores account, and it is the stores duty to charge out the material as it is called for, to the various works order numbers.

The official books, therefore, always show a running balance representing the value of goods in stores, and the balance struck at the year's end should agree with the value found by the independent stock-taking. Of course an exact agreement cannot be expected, and is, in practice, not attained, but the difference only represents a small percentage (under 1 per cent.) of the total issues, and can be dealt with in a simple manner.

One advantage of this method of stores book-keeping is that the books serve as a check on leakage in the stores, although its value in this respect must not be over-rated. The point is, however, that such a system is necessary if accurate cost keeping is to be attained.

The routine to be adopted in the stores to carry the above system out, will vary with circumstances, but it must be arranged to cut down clerical work to a minimum. As a general rule, when the works instructions are issued for a works order, a complete schedule of the material required is issued to the stores. This should be priced by the stores, any items not called for, struck off, and any additional material called for, entered thereon, and the so obtained cash totals of issues returned weekly, or monthly, at the least, to the accountant's office. The stock account should therefore read as follows:—

STORES ACCOUNT.

Dr.			Cr.		
1910.			1910.		
Jan. 1.	To value of stock ..	£1,000	Jan. to Dec.	By transfers to W.O. Nos. as follows:	
Jan. to Dec.	„ goods received ..	1,000	Dec.	„ W.O. No. 10	£700
				„ W.O. No. 20	500
				„ W.O. No. 30, &c. ..	200
			Dec. 31.	„ Stock in hand, as per stock sheet	570
				„ Depreciation of stock	30
		£2,000			£2,000

FIG. 1.

The item for depreciation may or may not come in. In taking stock the goods will be valued at the prices they have cost, and therefore the stock sheet value will equal the above value of stock in hand, plus the depreciation. Sundry items may, however, have depreciated in value, and these are, therefore, written down, so that the value of stock in hand transferred to the balance-sheet will be the true value. When, however, the depreciated articles are used they will, of course, be charged out in the costs at their depreciated value. This may, or may not, affect the selling price.

If the former selling price be obtained, the job will rightly show an increased profit, while the charging out at the depreciated value will indicate whether it is possible to sell at a reduced price without loss, or to what extent extra trouble and expense may be incurred in order to clear old and obsolete stock. It may appear foolish to point out that it does not pay to spend money beyond a certain limit to dispose of old stock; but, nevertheless, in a large works the danger of this is an ever present one. This risk is guarded against if the accounts be kept in the method recommended, as the storekeeper has to hand always the definite figures to guide him and prevent him, in his laudable efforts to clear out his immovable stock, from actually incurring a loss.

Labour Cost.—The system to be adopted for recording labour costs will depend upon the method of payment for work done, that is in use. We will assume, however, that the piece work system is in force, and that the works is provided, as it should be, with a piece-work price-fixing department under the immediate control of the works manager. As soon as the drawings and schedules are issued, the piece-work tickets for each operation are made out stating the particulars of the work to be done, the price to be paid and the shop where the work is to be carried out. These tickets should either be issued immediately to the foreman concerned or held back for a certain time at the discretion of the works manager. It is a mistake to always hold back the issue of the ticket until the material is absolutely ready to go on to the machine. If this be done the foreman has no chance of knowing what work he has ahead of him so that he can arrange his lay out properly, nor to give the necessary preliminary thought to each job to ensure its going through as expeditiously and as economically as possible. The works manager, if he have discretion, will arrange that the foremen will always have a reasonable amount of work in hand, without, however, being overwhelmed with tickets, the work on which may not be able to be proceeded with for a long time to come.

Now, at first sight, a complication arises with the recording of labour costs on the piece work system in that on some jobs the man will not earn his time rate of pay. He is generally, however, paid, as a minimum, his time rate, and therefore the cost of the labour is really higher than the piece work price paid. It would appear rational, therefore, in such cases, to book as costs against the job the wages actually paid rather than the piece work price. The difficulty, however, arises that on the next job the man may earn a bonus, and, of course, the debt he has incurred on the previous job is deducted before any of the bonus is paid. On the other hand, the man may leave and his debt is irrecoverable, and in practice it is generally found that there is a sum of money in suspense as shop debt.

A consideration of all the circumstances, however, leads to the conclusion that the correct figure to record as the labour cost is the piece work price paid. The loss incurred through shop debt should be dealt with by the loss account and eventually charged as a general charge every week or month. The amount so dealt with should be worked out as a percentage, and can be watched to see that it remains within a reasonable limit.

It is needless to say that the foregoing presupposes that the price fixing is accurate. It is safe to assert that nothing will disorganise a manufacturing concern so quickly and so effectively, as inaccurate piecework price fixing. So important is this that it is necessary to have some means to hand for an independent check of the piece rates. It is not sufficient to see that the workmen neither incur heavy debts now draw continually large and unreasonable bonuses. It is quite possible for the workmen to be earning an unfair bonus on one job and incurring a large debt on another. If it about averages out for him he is content, but from the firm's point of view the thing is entirely wrong. The best way this check can be obtained, is for the time taken on each job to be recorded. Automatic means are to hand to do this simply, the best, no doubt, being the automatic time recorder which stamps the piecework ticket with the time at which the job is started and finished respectively. By these means the amount of bonus or debt on each job is found out, which not only serves as a check on the price fixing, but is of extreme value as indicating where economies in production may be effected. The amounts of wages thus paid will be booked against the respective works order numbers weekly, for which purpose a labour summary card can be used conveniently, and the totals must, of course, agree, allowing for losses, as above mentioned, with the actual money paid out by the cashier.

(To be continued.)

Post Office Messengers.—The P.M.G. intends to provide occupation for about 200 of the 4,000 messenger boys annually dismissed by training them as linemen for enlistment in the Royal Engineers, and as wireless operators for the Royal Navy.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment No letter can be published unless we have the writer's name and address in our possession.

"What's Wrong with the Colleges?"

Your contributor, "A University Lecturer," states on page 211 of your last issue, that university students are frequently slackers, refusing to attend lectures before 10 a.m., and in confirmation he tells a story about my students and myself. I do not know on whose authority your contributor publishes a story which is certainly unfair to my students because it is not true. The plain facts are these: Owing to a local condition, lectures at the new building used to commence at 10 a.m., but when the departments of physics and chemistry had been moved to the new buildings, lectures here were advanced by half an hour, so that now both in the old and the new building lectures begin at 9.30. It has never been the intention of the university authorities to start lectures at 9, and there could therefore never have been a protest from the students on that point. There was absolutely no protest when we advanced the lectures by half an hour, and even extra lectures, which I found myself forced to insert into the original programme, are cheerfully and punctually attended. Your contributor's reproach that the students at Birmingham are slackers is quite unfounded.

Gisbert Kapp.

University of Birmingham,
February 10th, 1911.

Trade Discounts.

I enclose you a copy of a letter sent by the ——— company to customers of mine who are provision merchants, on whose premises I am at present installing an electric installation. They enclosed a list of motors and several other electrical apparatus, lamps, &c., and attached to each list was a printed "discount to the trade" slip. Surely the electrical contractors would not support this underhand method of doing business.

S. J.

Limerick's Engineer.

My letter regarding the above appointment having been remarked upon by two of your correspondents, I feel called upon to reply in defence of my statements. "Irishman's" letter treats the subject fairly, but asks why the Council should be accused of bigotry, and why I bring the religious question into the matter? Unfortunately, it is nearly impossible to consider any Irish question without religion being taken into account, but whether I am correct or not in putting this forward as a reason for the other applicants being passed over, it is very significant that when I offered the suggestion of religious influence I had no proof that the gentleman elected was a Roman Catholic. It appears, however, that I was correct.

"Irishman's" last statement "that we do things 'cuter' on the East Coast," &c., seems only to confirm my view that religion may enter into the matter, and while I agree than an English or Scotch Council would never be accused of bigotry over a similar appointment, yet I am dealing with Ireland where only such things happen.

With regard to Mr. Murphy's letter, he seems to think that I am taking a biased view, and to save any misunderstanding let me say that I am not, being perfectly ready to admit that it would be equally hard for a Catholic to receive an appointment under an Irish Protestant Council, as for a Protestant to become chief engineer of Limerick electricity works. He states that any well-educated man should have a knowledge of Irish history. Quite true, but why the Irish language also? I wonder how many of Limerick's citizens make use of it for their ordinary daily speech. In any case, he loses sight of the vital point that these two items were considered by the Limerick Council to be more useful in an electricity undertaking than first-class technical knowledge. All he proves is that the Council did not know its own needs.

Regarding the requirement of Irish or Gaelic in ordinary

commercial appointments, this is quite a different matter, the languages being mostly called for as an extra subject, just as Latin or Greek would be in a University examination, but a commercial appointment in an Irish country district or in the Shetlands, say, is quite a different thing from a city engineer's position. Did Mr. Murphy ever hear Kipling's poem about the person who received a military appointment because he sang so well?

I regret that I seemingly particularised the west and south of Ireland as being full of religious influence mixed in ordinary business, as the same remarks would apply to all parts of the country, but as he has chosen to take my statement as a slur on what I suppose is his native place, I will hold to my remarks, merely asking him how it is that although the Protestants in Dublin pay nearly 70 per cent. of the rates, there has not been a Protestant mayor of Dublin for 25 years. This, of course, is the east of Ireland, and possibly as the position is a *paid* one, it is hard to find anyone to take it. When I said "such happenings were of daily occurrence," I meant it with regard to appointments generally, and not city engineers in particular.

Regarding the Chief Secretary's list of public appointments, were not the majority of people appointed Englishmen?

Surely Mr. Murphy does not allude to appointments made by local councils. The words "their share" used by Mr. Murphy, I suppose stand for a non-party opinion. If I put on the prophet's mantle, a few more specimens of open appointments such as Limerick, would put "even Saul among the prophets," so I leave your readers to decide whether Mr. Murphy or myself is nearest the truth.

Fairplay.

The Value of Popularity.

From time to time one reads in your "Correspondence" columns pessimistic letters from aspiring young engineers and others who happen to have been passed over and preference given to an "inferior." One cannot help noticing that those who seem least fitted for the job usually get it.

It seems peculiar on the face of it, that if these appointments are filled by such men, they do not soon begin to go wrong; but one usually finds that everything goes on quite as smoothly, if not better than before. I have therefore made an attempt to solve this mystery, and the conclusion I have come to is, that it is the *popular* man who gets the luck.

If a man has an amiable and "Don't care hang" disposition, and does not worry about anything, his nature appeals to practically everyone, and his company is sought after more or less; in this way he eventurally gets in touch with the higher officials, both in and out of business hours; and with those minor persons who happen to have influence of some kind. Head officials nowadays are not as a general rule men who do not seek to enjoy themselves in other company when the day's toil is over. Now, it stands to common sense and human nature that if a man has a friend to whom he can do a good turn, he will give him preference to a comparative stranger; and so it is that the popular man gets on.

It may be argued as to how he gets his experience; but if one thinks twice it is easy to see that he has a far better chance of gaining experience than others of a different nature, as, out of business hours, shop of some kind is usually spoken about. By shop, I do not mean worrying problems and such like, but little incidents that occur out of the ordinary—little confidences given and taken, and heaps of little things which are the very essence of what is required of a man from the point of human nature to get him on in this world. A vast amount of experience is gained in this way. It is unnecessary to point out the amount of experience that can be gained by such men during business hours by a popular connection with everyone.

Now, we will take the man who is always studying and taking a vast amount of interest in his work; so long as his work goes all right, no notice is taken of him. If he introduces anything new, human nature causes his superior to take as much of the credit as possible, and his ability never carries him any farther. His study and industry are all for work, and somehow or other that is not what appeals to others generally. He does not think to study that mysterious something which is absolutely vital to the man who wishes to succeed in this world. I cannot explain what it is beyond the simple word popularity. If by chance he does get a move into a better position (which experience proves is very rare indeed for such men), he is quite conversant with the scientfic side of his work, but that is less than one-half of what is required in business life of any kind, and the consequence is that he lacks the power of making things go. Whether or not such a state of things should exist, I do not wish to express an opinion, but it is human nature, and human nature is bound to top over everything else. Everyone has the same chance from the point of view I have attempted to explain above, of looking at things from an optimistic standpoint and endeavouring to make themselves popular with others. If they recognised it, I think their chances of climbing up would be materially increased.

Optimist.

Rail Corrugations.

I note in your leader on "Rail Wear" in issue of February 3rd, that you refer to the grinding out of corrugations. This grinding out strengthens the view I have long held as to the cause of this trouble; I submit that formation of corrugations is entirely due to the "rigidity" of the track as a whole.

The rails in modern practice are laid solidly in concrete, and the result is they are dead and incapable of absorbing the vibration set up when brakes are applied.

Curiously the corrugations appear to bring about their own downfall. As the corrugations are being formed, the rails get a severe pounding, and in course of time become loosened, and the concrete beneath becomes pulverised, and a more suitable bed is established and rigidity is lessened. The rail now being alive and not so repellent, the wheel jumps a less distance and hits the peaks of the corrugations. As the rigidity is reduced, the corrugations multiply, but become less defined, until ultimately, as conditions improve, they develop into a straight line.

In conclusion, I think that a more elastic system of rail setting would greatly increase rail and tire life.

J. S. Haswell.

Middlesbrough, *February 13th*, 1911.

Live-Steam Heating of Feed Water.

With reference to your leader in the current issue, I should like to refer you to the letters in the present issue of the *Engineer*, where one of the writers gives one of the most obvious reasons for the *assumed economy* in the heating of feed water with live steam. He points out that the introduction of cold water into the steam space of the boiler is the factor which apparently gives the economy, but, in fact, there is no economy at all, the result of the cold feed being to produce wet steam, and the conclusion is arrived at by the faddists that there is a saving when none exists.

That writer is nearer the truth than any other who has ever yet sought for a proper explanation of the result of heating feed water with live steam.

If there was ever a bit of absolute foolery in connection with engineering and steam boiler practice, it is this absurd contention for economy by this system.

You, Sir, are familiar with the famous economies which were obtained many years ago on trials made before the priming of boilers was fully understood, and I think I am well within the mark, without looking up the matter, when I say that many engineers have published figures giving as much as 13 and 16 lb. of water evaporated per lb. of coal.

I would mention that no proper explanation has yet been put forward for the assumed economy, but I will point out that it *does not exist in theory*, and when the faddists make their claims, assumptions have to be introduced to bolster up the wonderful and glowing accounts.

If Prof. Gibson wants to justify his claims for economy he will have to do something better than conduct his trials on the toy boiler of a University; I would point out to him that when Prof. Goodman investigated the system, he did so in a practical manner on a substantial boiler running on a real live working load; and I say, without fear of contra-

diction, that the trials made by Prof. Goodman were more reliable than those of Prof. Gibson.

I note that the writer of your article makes a point of there being a saving of 5 per cent. on light load and an additional 3 per cent., making 8 per cent. for heavy loads. The explanation of this is, no doubt, that there was priming or a larger percentage of wet steam on the heavier loads.

Your writer concludes with the words of wisdom—"With so much in its favour, it would appear that there must be an economy"; but if the writer of your article had had as much experience as the writer of this letter, he would never have penned such words.

No one has yet established a theory by the practice of live steam heating, and if anyone has ever noticed steam maintained better with it, he should also have noticed the weather on the occasions when the boiler was run without it.

It does not matter one straw what form of this system is tried, there is not the slightest economy in coal to be derived by its use.

I have had it tried in Lancashire, Babcock & Wilcox, and Davey Paxman dry-back boilers, and who wants to try it in any other type of boiler to prove its efficacy?

I say, from my experience, that live steam heating from beginning to the end is a pure myth when economy is claimed as part of its virtues. When you have seen the system in operation as I have seen it, test after test, trial after trial, on a practical working basis, burning coal against units delivered at the switchboard, and trained engineers engaged in the study of the system, well, after that you are able to speak with something like authority on the matter, and I tell you, Sir, and I tell your readers that not one solitary claim has yet been established, in whatever boiler you like to name, for economy on the coal bill, that could not have been obtained in the same boiler with due care in firing.

I know, and I will put my experience against all those who contradict it.

John I. Hall.

London, W.C., *February 13th*, 1911.

Electricity in Mines.

Your correspondent "Celt" does not state his case very clearly, for he complains that most colliery electricians gain their knowledge by pick-up-as-you-go-along methods and says the rate of wages for charge electricians is ample. Ample for whom? the pick-up-as-you-go-along electricians, or the competent men?

The list of qualifications for a competent electrician judging from the President of the Mining Electrical Engineers' annual address is a formidable one, and I maintain that the salaries at present paid, do not repay anyone for the time and trouble taken to obtain the qualifications required. In most cases the colliery electrician has a weekly salary, and in addition to working his ordinary hours (often from 6 a.m. to 5 p.m.) he has to work overtime, which cannot be entirely avoided at collieries.

He has to go underground and run even more risks than the miners themselves, as he has to travel the main traffic roads (which the miner is forbidden to do) and run the risk of being knocked down by runaway tubs (a great danger in the steep seams of South Wales), and there is always the possibility of receiving a fatal shock. He has a hundred and one duties and, if a conscientious man, has never an idle hour; he has often to run the gauntlet of severe criticism from colliery managers whose knowledge of electricity is gleaned from text-books; and all this, often for the magnificent sum of 30s. to 40s. per week. I know several charge electricians whose salary is 35s. per week. Does "Celt" consider that ample?

The enginemen in the power house often earn as much as the electrician in charge. Is that any encouragement for a man to work hard all day and study in the evening?

It appears to me that "Celt" is not a charge electrician, or he would know to his cost the danger of allowing motormen to interfere with electrical apparatus.

Is an express locomotive driver bound to study the theory of steam? No. Then why should a motor driver be bound to study electricity?

Motormen should not be allowed to interfere in any way with electrical apparatus, but enough competent men should be kept, so that in case of a breakdown there would be no undue delay.

And to get competent men larger salaries must be paid, so that it will repay a man for his years of study and hard work.

There is some correspondence in your columns regarding the pay of station engineers, whose work is certainly not so arduous as the colliery electrician's, therefore I say again the scale of wages ought to be raised.

Trician.

Electrical Trade Difficulties in India.

The enclosed extract from letter received from one of our clients, an electrical engineer in India, may be of interest to you and your readers.

It seems to us that this burking of the Government orders for drawing supplies from local firms is a serious one, to which attention should be called.

Exporters.

Extract of Letter from the East.

Engineering business in India is, I am sorry to say, getting worse and worse. One used to say that engineering was the science of common sense; if that's still true, I can only say they keep the C.S. in the workshop and leave none for the office. The senseless competition that goes on is incredible. No one benefits. I dare say you read the report of a certain very large and well-known (here) firm ——— £31,000 loss, I believe, mostly ascribed to cut prices in the foreign and colonial branches. Yet that firm is still quoting prices that their own home office have publicly admitted are *below works cost*.

Jones cuts the price of his motor because he wants the wiring work, and is content to put the motor through for nothing. Brown cuts the wiring work, because he wants to sell his motor. Robinson, who knows no better, cuts both, because he doesn't know anything about costs, and reckons that if the items will severally pay Jones and Brown, they'll pay him. Result, Robinson gets the job, feels the heat on his fingers before he gets it through—scamps it, and just wriggles through the test. Jones gets nothing, Brown the same; Robinson loses money, and the purchaser gets a pup, and goes round damning machinery. Good for trade, isn't it? It's not a bit exaggerated; it is just standard pattern British business methods—at least in the engineering trade. I believe the dealers in pots and kettles manage more sensibly; I suppose their wares demand less brain exercise, so there's some left over to sell with.

Another thing that has very much upset trade calculations generally, is the failure of Government to provide any local business. You will, doubtless, remember that, just about the time you came out, Government announced with much publicity, that in future they would place orders in this country and through local agents, instead of through the India Office, so long as officers were satisfied that the quality would be the same, and the cost no greater. They didn't forget to make this public. In the course of 12 short months, they managed, by a series of inoffensive little "orders" to entirely abrogate this alleged resolution, and a few months ago the Chief Engineer P.W.D. told me personally that they were worse off in this respect than ever. Needless to say, they didn't trot out the flourish of trumpets, when they issued the later orders—that was done very quietly.

The climax came about two months ago, when (trumpets again, please) they published a resolution that, in the event of urgency, when officers were able to satisfy the heads of the departments that the public service would be injuriously affected by delay, purchases might be made locally, provided that the cost did not exceed that of import through the India Office, provided also that the quality, &c., were equal, and provided especially that the goods be actually in India at the time of order. Did you ever hear such a bit of cheek? Dealers, of course, are going to stock goods for Government requirement, and sell them at indent prices, just when Government want them urgently only.

Of course, the real meaning is that goods are not to be purchased under any other circumstances, and the notice was followed by a departmental circular giving special warning against the practice of creating urgency by postponing the order till urgency be created; or of holding up urgent orders while goods are got out by dealers. It is this, and this only, that has been the cause of no results for ——.

I suppose in a few years' time, when the engineering trade here gets well into the hands of the natives, they will bring pressure to bear on the India Office, and get this disgraceful state of things ended. But, of course, so long as only Europeans are affected, it is hopeless to expect anything from the Government.

A Leicester Sale.—Presumably owing to the recent decision respecting free wiring work, the stock of electric fittings and accessories belonging to the Leicester T.C., and amounting in cost price value to £530, is to be sold by public tender.

AUTOMATIC VOLTAGE REGULATION.

From time to time numerous attempts have been made, with varying success, to substitute for the hand regulation of the voltage developed by an electric generator some means of automatic control. That such apparatus is needed does not appear to require much emphasis in view of the erratic voltage charts which are unfortunately to be found, even at the present day, in some of the power houses of this country, and provided that it is certain in operation, inexpensive to install, and economical in maintenance, there is every reason why such automatic control should merit the attention of every station engineer who has any regard for the quality of his supply.

For this reason we were more than usually interested to receive an invitation from Mr. H. M. Taylor, the Corporation electrical engineer of Middlesbrough, to inspect a control device which he, together with his assistant, Mr. R. H. Scotson, has designed in order

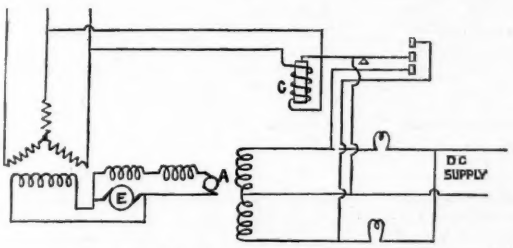


Fig. 1.—Diagram of Connections.

automatically to vary the field of a dynamo or alternator so as to maintain the pressure between the conductors at any required point on the supply system at a constant value. The particular installation which we inspected through the courtesy of Mr. Alfred S. Blackman, the borough electrical engineer of Sunderland, is installed at the Hylton Road generating station in that town, and has been in continuous operation for several weeks. We were given full facilities for the inspection of its operation during a very heavy variation of load, this falling from 2,600 KW. to 1,500 KW. in a few minutes, owing to the shutting-down of the shipyards for the dinner hour, and there was in addition a very heavy series of fluctuations continually in progress due to the operation of the Corporation tramways. Under these severe conditions the apparatus worked perfectly, and we were assured by the operating engineer of the station that the apparatus had required no alteration or adjustment during the whole period of its use, and that it had given a close approximation to perfect regulation.

The plant on which it operates is a 2,000-KW. turbo-generator set which, during the major part of the day, runs in parallel with a 750-KW. reciprocating set; on the afternoon 4 to 5 peak load, which increases up to 5,200 KW. (which was the maximum Christmas load), reciprocators of 750 or 500 KW. are paralleled as required. Under no conditions of running is there any trouble with regard to the voltage regulation, as the regulator is capable of taking care of 1½ per cent. variation of speed on either side of normal in addition to the load variation, which, owing to the tramway service and shipyard load, amounts to 250 KW. either way from normal from moment to moment. On such a load, the maximum variation observed on the indicating and recording instruments was only ½ per cent. in either direction, whereas it was previously impossible to keep the variation within 1½ per cent. in either direction, even with the closest attention on the part of the switchboard attendant.

The way in which this automatic regulation is effected is by placing a small shunt-wound generator in circuit with the exciter field. The field of this small generator is split into two halves, each half being fed from any direct-current supply, and producing opposite polarities. The effect of this is that the armature gives either an assisting or opposing boost to the exciting fields, according to which half of its own exciter field is in operation. In order to avoid sparking, the two halves of the auxiliary generator fields are supplied through resistances which may each be conveniently a 16-C.P. lamp, and each section of the field is cut out when necessary by short-circuiting the terminals of the field coil, as shown in the diagram, fig. 1. In this diagram, E is the armature of the main generator, which is placed in series with A, the armature of the auxiliary generator. This is acted upon by the separately excited field split into two halves, as shown, while, from any point on the main supply on which it is required to maintain constant potential, tappings are taken to the windings of the solenoid C, this coil being a pressure coil across the voltage of supply. The core of this coil is attached to a suitable switch designed to short-circuit either half of the generator field by the play of the contact arm between two fixed points connected to the motor-generator fields, and this play is controlled by the position of the core in the solenoid C, which in its turn is controlled by the strength of current passing through C, and, therefore, the voltage at any moment between the points of reference selected. It will be seen that in the Taylor-Scotson device indicated above, the whole of the assisting or opposing boost is given at one step to the exciter field circuit, and this is analogous to the operation of the Tirrill gear, where the whole of the resistance in the exciter field circuit is inserted or cut out at one step. This totalising of positive or negative boost makes the regulation effected by the Taylor-Scotson apparatus very quick and accurate. Fig. 2 is a view of one of the Taylor-Scotson regulators which has been erected at Messrs. Bolckow, Vaughan's steel works at Middlesbrough, for the purpose of controlling three 1,000-KW. exhaust steam turbines. This installation has been in continuous operation for a considerable period, and under the exacting conditions of load necessitated in this industrial supply has given complete satisfaction, one switch controlling any or all of these exhaust steam turbine sets. The actual arrangement of the parts of the apparatus will be readily followed on the photograph. Two refinements may be noted; one of these is an auxiliary contactor for the purpose of cutting out the automatic voltage regulator should the variation of voltage be abnormal from any cause, such as a short-circuit on the mains. It is evident that in such conditions it would be inadvisable to boost the field up indefinitely without some arrangement whereby the voltage might be allowed to drop under exceptional conditions, and for this reason any abnormal movement of the core in the solenoid brings into operation the auxiliary contact, by means of which the field winding may be rendered inoperative when the voltage generated is diminished; this is arranged in such a way that it can come into operation when the voltage to be controlled falls considerably as well as when it rises. This safety device involves the provision of a second auxiliary device placed at the lower left-hand corner of the panel, whereby the apparatus can be put into operation by hand should it be tripped out of action at any time under the conditions above-named. The illustration also shows the motor-generator set which is used in the operation of this system. This consists of a 1¼-H.P. motor running at about 1,500 R.P.M., and direct driving the booster with split field above described, which is capable of giving a boost of about 120 volts in either direction on a normal field voltage of 200. The booster is, of course, wound to accommodate the field current of the exciter, and it will be easily seen that by making the motor-generator of sufficient current-carrying capacity and boosting power, one set could, if required, control a complete power house equipment. This is one of the great advantages of

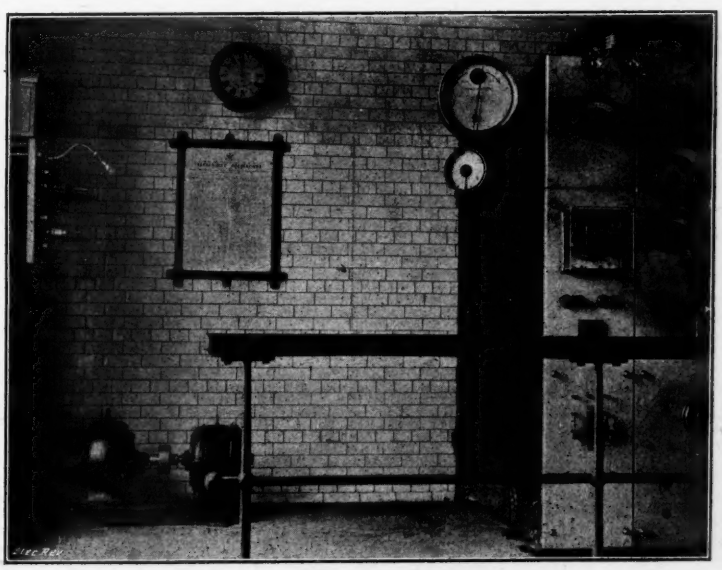


Fig. 2.—Taylor-Scotson Automatic Regulator.

the system, as alternators of various types and quite different excitation voltage may be regulated simultaneously with one regulator without paralleling exciters. Moreover, it is adaptable to existing plant, as the amount of boost which may be given to the exciter fields is only limited by the saturation point being reached. At Messrs. Bolckow, Vaughan's, the regulator is not only controlling the voltage on loads varying from 200 to over 1,000 KW., but also on a power factor of from 65 upwards, and it has been working for 24 hours per day for a considerable period without the contacts being touched.

During our inspection we were particularly careful to examine what is often a source of weakness in point-contact methods of control, that is to say, the probability of wear in the points. We were, however, unable to detect the slightest degree of sparking at

the contacts, and in view of the operating engineer's statement that no adjustments in this respect had been made, it would appear that the short-circuit method of control has successfully overcome what has previously been a very serious defect. The system of operation adopted at Sunderland is to leave the hand regulator at about running point, so that should the regulator fail through any cause the voltage is left at about normal point, and can be hand regulated. Up to the present, however, this has not occurred, the only times when the apparatus has been taken out of commission being when it has been thought advisable to examine the running condition of the motor-generator. The adequacy of the arrangement as used at Sunderland is demonstrated by figs. 3 and 4; the first shows a typical daily load curve of the station taken from the half-hour readings. This does not, of course, take any account of the heavy momentary surges of the traction and power load; but as it stands, it shows sufficiently well that heavy variations of load occur. Fig. 4 shows the voltage curve for a similar daily period, which, under the action of the Taylor-Scotson apparatus, is monotonous

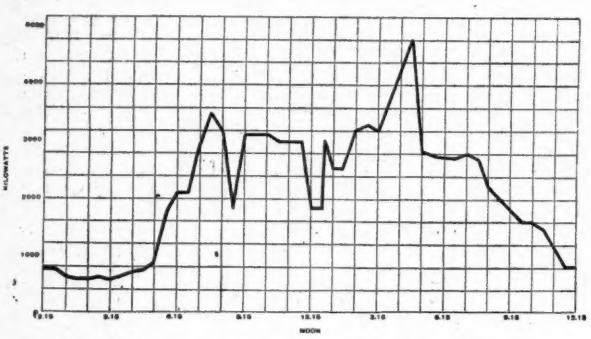


Fig. 3.—Load Curve, January 13th, 1911; Sunderland Corporation Electricity Supply.

in its regularity. The only periods at which hand regulation is necessary are at the time of taking out or putting in a machine into parallel; at other times the only regulation required is upon the engine to keep the frequency within limits, the voltage regulation being looked after automatically.

In addition to the two layouts already mentioned, it is interesting to refer to the continuous-current installation at the Middlesbrough Corporation generating station. The automatic device was first applied here as the result of Mr. Taylor's endeavour to keep the voltage constant at a point 2 miles away from the generating station, and was evolved from the original voltmeter contact type to its present commercial form. In this station the regulation with one layout is effected on any of the following direct-current plant:—One 100-kw. high-speed reciprocating set, two 300-kw. high-speed sets, and one 600-kw. turbo-generator. It is in regular operation regulating a feeder booster in reference to a point on the

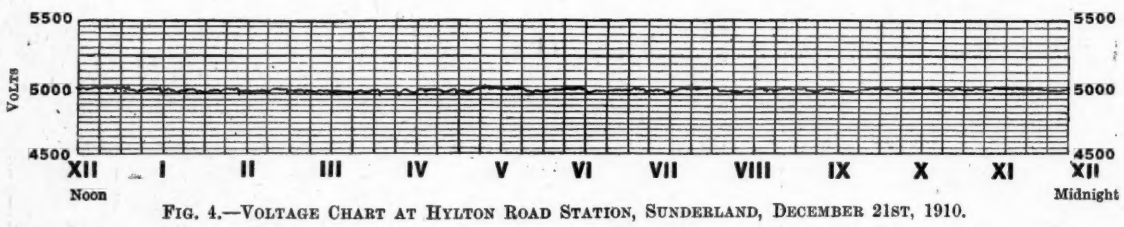


Fig. 4.—Voltage Chart at Hylton Road Station, Sunderland, December 21st, 1910.

network two miles from the works, and as the network is interconnected, the supply voltage of the whole town is thereby automatically regulated. It is also possible to run the feeder booster as a floating booster in series with the main battery on automatic control, and hence the Taylor-Scotson apparatus provides a means of booster battery regulation which is evidently cheaper than some of the types of special machinery which have been evolved for this purpose.

In view of the above interesting results, it is not too much to say that a marked advance has been made in the science of pressure regulation, which should have a material effect on the economical running of generating plant, inasmuch as it dispenses with a considerable amount of manual operation and supervision without adding appreciably to the capital cost of the undertaking. In view of the very small amount of energy absorbed in running the motor-generator combination compared with the total output of the generating plant which it controls, the system is worth careful examination on the part of engineers responsible for the design and operation of public and private lighting and power stations.

Plymouth Tramways.—The Council has decided to equip its tramway cars with "Ferranti" meters for the purpose of checking the consumption of energy. The cost is estimated at £108.

ELECTRICITY IN MINES.

The Report of the Committee appointed by the Home Office in October, 1909, consisting of Mr. R. A. S. Redmayne, Chief Inspector of Mines, Mr. C. H. Merz, and Mr. R. Nelson, Electrical Inspector of Mines, to consider the Special Rules for the use of electricity in mines, has now been published. The rules at present in force have been in practical operation for about five years, and during this period the growth of the use of electricity in mining has been very remarkable.

The Report states that so far as the Committee is aware all the societies, institutions and associations interested in the matter either communicated with the Committee or were written to, and representative witnesses were heard. Two or three individual witnesses also offered evidence, and all such evidence was taken. Four Divisional Inspectors of Mines were called into conference by the Committee towards the end of the proceedings.

To-day electricity is applied in one part of the country or another to every operation requiring mechanical power in and about a colliery. Concurrently with increased use there has been evolved a change of system, from direct current to three-phase alternating current, and the majority of the larger colliery installations at the present time are of this kind. This change in the prevailing system of distribution for underground work is the most important development since the last inquiry, and in the opinion of the Committee is in the right direction.

Experience has shown that the proper use of electricity cannot be regarded as inherently unsafe, and that it possesses some characteristics which are of great advantage in underground conditions, but having regard to the change in the prevailing system of distribution and to the natural development of apparatus, the Committee is of opinion that the existing rules require revision.

The revised rules are intended to apply to apparatus below ground, with the addition only of such surface apparatus as may directly affect the safety of persons in the mine.

Due chiefly to the improved mechanical construction of apparatus, good present-day practice is much safer than was the practice of four or five years ago. The primary object of the rules is to specify the precautions which should be observed in the selection, installation and working of electrical plant. For this purpose it is only necessary to insist that certain general principles of construction shall be observed, hence the omission from the revised rules of certain requirements which the existing rules endeavour to deal with in detail.

The Committee recommends that the revised rules be made to apply to metalliferous mines as well as to coal mines, as there is no essential difference between the conditions in a metalliferous mine and those in many stratified ironstone mines and naked-light coal mines.

The possible dangers which may arise from the use of electricity below ground may be divided into the risk of ignition of explosive gas, coal dust, or other inflammable material, as a result of open-sparking and the risk of electric shock. Though the number of ignitions causing accidents to persons and the number of deaths from the effects of electric shock both show a tendency towards increase, the rate of increase is relatively small, having regard to the amount of electrical plant in use underground to-day as compared with that in use five years ago, indicating improved apparatus and methods. The number of fatal accidents due to the use of electricity in mines in any one year has never reached a figure greater than 1·54 per cent. of the total number of fatal accidents in mines. It does not follow that the position attained is a satisfactory one; on the contrary, almost every electrical accident is preventible. The feeling against the use of electricity in mines which found expression in some parts of the country was largely based, the Committee considers, either upon a vague fear due to lack of knowledge, or upon experience of the behaviour of badly constructed or badly maintained apparatus. The Committee knows of no place below ground in which electricity is in use to-day where both kinds of accident would not be avoided if the best present-day practice as regards construction and maintenance were complied with.

There are parts of some mines from which electricity should be excluded altogether, and in this respect the existing rules require amendment. On the other hand, prohibition is not required where gas is seldom found, or where it is likely to be of rare occurrence; in such places certain additional precautions are called for by the revised rules.

Before electricity is introduced into any mine, or carried into a new district of a mine, formal notice should be given to H.M. District Inspector of Mines. Should the Inspector raise objection, it is proposed, failing subsequent agreement, that the question be referred to arbitration under the Coal Mines Regulation Act.

As regards the prevention of shock, it is generally agreed that even moderate pressures under the conditions commonly met with underground may be dangerous to life, and therefore all apparatus for underground use should be so constructed, installed and maintained that, so far as is practicable, the danger of shock is altogether removed.

Proper design and good construction and workmanship are too often absent from colliery installations, and apparatus is bought on account of cheapness rather than on account of quality or suitability of design for the purpose in view, a tendency the effect of which is augmented by the intense competition among manufacturers of electrical apparatus. The use of properly designed and well-constructed apparatus certainly results in a saving of maintenance costs, and if apparatus be chosen with proper regard for its purpose it need not be expensive even in first cost, as simplicity of design and construction are essential features of good apparatus.

The Committee cannot accept the suggestion that the Home Office should officially approve certain types or designs of electrical apparatus for use underground.

All underground apparatus requires periodical examination if accidents and dangerous occurrences are to be avoided, and the competence of the person appointed to supervise electrical plant below ground is therefore a matter of great importance. The existing rule which deals with this point reads as follows:—

"A competent person shall be on duty at the mine when the electrical apparatus or machinery is in use . . ."

But this, in the opinion of the Committee, is too vague. The revised rule provides that the person appointed to supervise the electrical apparatus ("the electrician") shall be appointed in writing, and be competent for the work he is set to do; and further, it clearly specifies the more important duties for the performance of which he must be responsible, without, however, interfering with the covering responsibility of the manager under the Coal Mines Regulation Act.

It was suggested in evidence that certificates of competency should be issued, after examination by the Home Office, to persons in charge of electrical plant in mines; but such certificates could only refer to technical knowledge, and the Committee considers that, however well certificated a man may be, considerations of habit and character are of even greater importance in this connection than technical knowledge. Safety and efficiency would be more likely to be promoted by the employment of a conscientious and resourceful man than by the employment of a man who may have the advantage as regards technical knowledge, but who is inferior as regards "thoroughness."

The use of electricity below ground has extended so widely that, in the opinion of the Committee, greater attention than is usual at present should be given to the electricity section in the examination for a colliery manager's certificate. If the colliery manager is not in the possession of at least a knowledge of the essential points of good apparatus and workmanship, he is unable intelligently to criticise and check the work, and he is in these circumstances completely in the hands of the electrician. Every colliery manager, for example, should be able to say whether a cable joint made or opened in his presence has been well made or not, and whether the joining up of cables to apparatus is well carried out or not. It is not suggested that the colliery manager need necessarily be qualified to judge as to the suitability of apparatus from an electrical standpoint, as this requires considerable knowledge and experience, and in most cases it is necessary, apart from the question of safety, either to obtain expert advice or to purchase from a manufacturer whose mining apparatus is known to be of first-class construction and liberal design. But however good the apparatus may be as regards construction, inspection and maintenance must be dealt with by the colliery staff, and it is, therefore, chiefly upon questions which arise in connection with maintenance that the colliery manager should be able to express an opinion.

The Committee has carefully reviewed the advantages and disadvantages of the direct-current and alternating-current systems, but except as regards the use of high-pressure alternating current, no actual distinction is made in the revised rules between the two systems.

Small transformers for reducing high or medium pressure to low pressure are now obtainable at comparatively trifling cost, and there is therefore no reason why 100 volts should ever be exceeded on any new underground lighting installation. In fact, with the much lower current consumption of modern electric lamps, low pressures such as 25 volts can be used for lighting. The switch and transformer can be combined to form one piece of apparatus (a switch-transformer).

(To be continued.)

French Electricity Stations for Sale.—Only occasionally does one read of central electricity stations being for sale. This is, however, the case with regard to the stations at Varney, Vilosnes, in the Meuse district of France, and at Monthureux-sur-Saone, in the Vosges, belonging to the Société Lorraine d'Eclairage et de Force par l'Electricité. The stations are being offered for sale at stated prices, and bids for the same are to be sent to Mr. Ernest Blume, notary at Verdun, Meuse, France.

Belgium.—La Société de la Lampe Electrique (Anciens Etablissements Schriebmann & Co.) is the name of a new company which has just been formed in Brussels with a capital of £4,400.

LEGAL.

Reorganisation and Control Co. *v.* International Motor Traffic Syndicate.

(*Continued from page* 215.)

For the plaintiffs, evidence was given by Mr. Ernest Matthew Nasary, member of a firm of electrical engineers, and an expert on electrical traction, who said that he was appointed a director of the defendant syndicate, and shortly afterwards visited the garage in Horseferry Road, and found there a number of electrobuses. Some eight or nine were in better condition than the others, and could have been profitably put on the road.

In cross-examination, he said he knew that the only omnibuses now remaining were those in possession of the Brighton Co., the others having been sold by the landlord under a distress for rent.

Mr. Edward Riches, secretary to the plaintiff company, said that he never selected any omnibuses as provided for by the agreement, and he had never been asked to do so.

Other evidence having been given for the plaintiffs, Mr. Gore Browne, K.C., for the defence, said that his case was that the eight omnibuses in question were not the omnibuses that were subject to the agreement.

Dr. Lehwess was called, and gave evidence as to the negotiations that led up to the sale to the Brighton Co.

Mr. John Clarke, chairman of the Brighton Co., also called for the defence, that his company entered into an agreement with the first defendants for the purchase of eight omnibuses. He knew at that time there were negotiations pending with the Receiver for the debenture-holders of the Electrobus Co. He never had any notice of any claim by the plaintiff company. His company received the omnibuses, and paid £3,411 odd for them.

Cross-examined, he said that he knew at the time the agreement was entered into the International Co. were not the actual owners, but understood that they were going to buy.

Mr. Gore Browne, in summing up the case for the International Co., said that he did not now claim that they had sold the 'buses as owners, under the selection clause in the agreement, but claimed that they had rightfully sold them as mortgagees.

Mr. Jenkins, in reply, said that he denied the International Co.'s right as mortgagees, and contended that under the circumstances that company would be entitled to an account of what was due to them, and the plaintiffs would be entitled to counterclaim against account for damages for wrongful conversion. The plaintiffs would be entitled to the value of the omnibuses as improved, because the people who had spent the money on them were not the International Co. but the Vehicle Co., who were mere trespassers.

His Lordship pointed out that the International Co. were setting up their claim as mortgagee, and the plaintiffs could not claim damages if the property was sold at a proper value.

Mr. Jenkins said that he asked for an inquiry as to damages, and that was all he was asking for, since the admission by the International Co. that these omnibuses were not their own property. He claimed damages generally, and having regard to the conduct of the parties as a whole, he submitted that he was entitled to the costs of the action. He was quite willing that the International Co. should have an account on their counterclaim

On the question of costs, Mr. Gore Browne submitted that if his clients were wrong up to a point, the plaintiffs were also wrong up to and beyond that point, for they had claimed the right to a delivery up of these eight omnibuses without any regard to the International Co.'s rights under the deed.

His Lordship, in giving judgment, said that the action had arisen out of the failure of the Electrobus Co., which at one time was carrying on a successful business, and whose vehicles were appreciated by the public. Though never actually carried out, he believed the parties acted on the terms of the agreement of January 11th. It seemed to him that it must have been known that the object of the agreement was to enable the Vehicle Co. to sell the eight omnibuses to the Brighton Co. It seemed to him that all the omnibuses were very much in the same condition, and, therefore, the non-performance of the condition as to selection was not a matter of great materiality. He thought that the position of the parties was that of mortgagor and mortgagee. There had been a sale by the mortgagee which it was now admitted was wrongful, and what he had to consider was what should be done under those circumstances. He thought there must be an inquiry as to the damage the mortgagor had suffered by reason of the wrongful sale, and the amount must be set off against anything that was due to the mortgagee under the mortgage. He would accordingly direct an inquiry on the claim and counterclaim, reserving the costs, and dismiss the action, with costs, as regards the Brighton Co., and without costs as against the International Co.

Humphreys *v.* City of London Electric Light Co., Ltd.

In the City of London Court on Friday, this case was mentioned under the Workmen's Compensation Act, in which, it was said, an important point arose. It seemed that on November 16th, 1908, Humphreys was employed by the defendants as an electric lamp trimmer at wages of 32s. 6d. a week. He was working at Smithfield Market when he cut his hand and it was poisoned. After three operations his thumb was amputated, and he was badly

crippled. The Fine Arts and General Insurance Co., Ltd., paid the workman half his wages, and after a time, the defendants offered to take him back and give him 25s. a week for light work. He agreed to take that, and was paid 3s. 9d. a week in addition under the section of the Act dealing with his circumstances, which said: "In fixing the amount of the weekly payment, regard shall be had to any payment, allowance, or benefit which the workman may receive from the employer during the period of his incapacity, and in the case of partial incapacity the weekly payments shall in no case exceed the difference between the amount of the average weekly earnings of the workman before the accident and the average weekly amount which he is earning or is able to earn in some suitable employment or business after the accident, but shall bear such relation to the amount of that difference as under the circumstances of the case may appear proper." The workman now said he was entitled to 7s. 6d. a week, and not 3s. 9d., on the proper construction of that section.

Mr. Washington, for the defendants, argued against that, and said that an agreement was come to between the plaintiff's former solicitor and the insurance company to take 3s. 9d. a week.

Mr. G. F. Kingham, for the workman, said the Court's decision would be very far-reaching, and if the Court now upheld the insurance company's view it would prevent injured workmen from trying to resume work.

Judge Lumley Smith said that the man's life had been spoiled by the accident, but he could not allow him 7s. 6d. as asked. The intention of the Act was that workman and employer should each sustain a certain amount of monetary loss. The application to increase the amount would therefore be dismissed, but without costs, as the man had received the 3s. 9d. weekly up to date.

Gill *v.* J. Stone & Co., Ltd.

On Friday, in the Second Court of Appeal, before the Master of the Rolls and Lords Justices Fletcher Moulton and Buckley, the appeal by the defendants in this action from a judgment of Mr. Justice Swinfen Eady in the Chancery Division, was concluded.

Mr. Bousfield, K.C., Mr. Astbury, K.C., Mr. MacSwinney appeared for the appellants; and Mr. Walter, K.C., Mr. Colefax and Mr. H. F. Moulton for the respondent (plaintiff).

After hearing the arguments of counsel on both sides, the Master of the Rolls, in giving judgment, said that what the Court had to do was to attempt to comprehend and interpret three agreements drawn up between the parties involving no legal principle whatever, but undoubtedly involving a very large sum of money. He had come to the conclusion that the decision of Mr. Justice Swinfen Eady was perfectly right. Having dealt with the facts of the case and read the material clauses of the three agreements—the first of which was made in 1893, the second in 1896, and the third on May 28th, 1900, his Lordship said he was unable to accede to the contention made on behalf of the appellants that Mr. Gill's notice to determine his position as manager determined the whole of the agreement of May, 1908. It was clear that the Court had to treat the defendants, the limited company, as liable to satisfy all the obligations of the firm of J. Stone & Co., and Mr. Gill was liable to discharge the limited company the obligations which were imposed upon him by the agreements. It was also clear that the plaintiff in the events which had happened was entitled to give the notice determining his managership, and he thought that that being so the plaintiff was entitled to such royalties and remuneration in respect of the patents as were provided to be paid by the third agreement. He was of opinion that that agreement was still subsisting between the parties in all respects excepting the position and employment of the plaintiff as manager. For these reasons he thought the appeal failed, and must be dismissed with costs.

The Lords Justices delivered judgment to the same effect, and the appeal was dismissed with costs accordingly.

London Electric Supply Corporation *v.* Westminster Electric Supply Corporation.

The action brought to restrain the defendants from soliciting or attempting to entice away the plaintiffs' customers, in alleged breach of the defendants' obligations under an agreement with the plaintiff corporation, was fixed for hearing before Mr. Justice Joyce in the Chancery Division on Wednesday, February 15th; but on the application of Mr. Younger, K.C., for the defendants, who said it would be a great convenience to both parties, his Lordship agreed to the trial being postponed until Wednesday, March 1st.

Allott, Jones & Co. *v.* Walsall Electrical Co., Ltd.

Before Mr. Justice A. T. Lawrence and a special jury, in the Nisi Prius Court of the Liverpool Assizes, on Monday, February 13th, this action for breach of contract was in the list for hearing.

Mr. Ashton, K.C., for plaintiffs, announced that the parties had come to an agrement. It was a long and complicated matter, and he doubted whether any jury could have tried it. The record would be withdrawn on terms which had been signed. The Judge said that he had read the pleadings and the case seemed a complicated one. He agreed with the course adopted.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Arc Lamp Accessories.

Messrs. J. & H. Grevener, of Eldon Street House, E.C., have introduced two new accessories for suspended arc lamps. Fig. 1 shows the interior of a safety winch, which can be wound in either direction and left in any position without locking or releasing any trigger, ratchet or other device; the heavier the weight, the

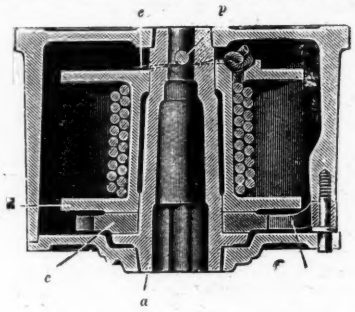
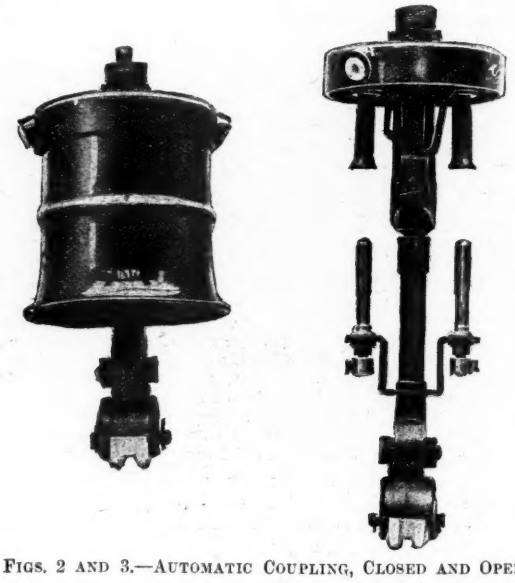


Fig. 1.—Section of Safety Winch.

tighter it grips, and if the handle drops out or the winch is carelessly handled, the mechanism is automatically locked. There are three rotating parts, the axle *a*, cogged locking collar *e* and the drum *d*. A ratchet *r* engages with the locking collar and allows the collar to turn clockwise only. When the handle is inserted and turned clockwise, the axle-pin *p* rides on the shelved surface of the drum-end *e* and binds the three rotating parts together; therefore the drum winds so long as the handle is turned in the same direction. The handle being taken out, the drum remains



Figs. 2 and 3.—Automatic Coupling, Closed and Open.

stationary, as the ratchet engages with the locking collar. To release the drum and unwind, the handle must be inserted and turned counter-clockwise, when the axle-pin will loosen its hold on the drum and allow it to unwind so long as the handle is kept turning.

Fig. 2 shows a new patent automatic coupling and safety-locking device, which is entirely weatherproof; the act of raising the lamp into position connects it to the circuit, while a locking device takes the weight off the rope. The parts are simple and strong, easy to inspect, and reliable in operation. Fig. 3 shows the device in the disengaged position.

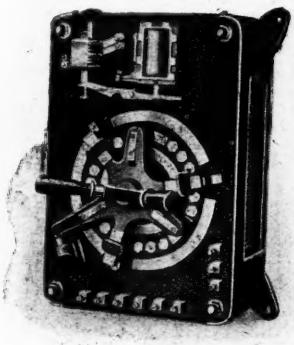
Westinghouse Starters.

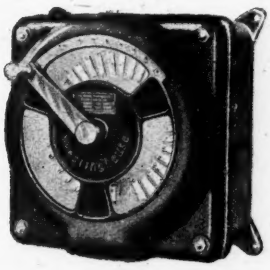
The British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park, Manchester, are now manufacturing a line of starters which possess some interesting features. Their type "Z" A.C. slip-ring motor starters are designed to control the rotor and stator circuits of the motor, thus enabling the use of separate main switches to be dispensed with. They are made with automatic overload and no-voltage release, protecting the motor against overload and failure of supply on one or all phases. Further, all release coils are in the stator circuit, and thus do not prevent the use of brush-lifting and short-circuiting gear. They are provided with renewable contacts in all sizes.

They can be used with three-phase or two-phase motors having two-phase three-wire or three-phase rotor windings. The resist-

ances are either of the cast grid or the Westinghouse patent unit type, and are designed to start motors of full-load torque up to 15 H.P. in ¾ min ; above 15 H.P., 1 min.

The type "V" three-phase rotor starters have similar ratings. They are fitted with renewable switch contacts for the switch, and the terminals are on the points of the switches. Retracting springs





FIGS. 4 AND 5.—WESTINGHOUSE A.C. MOTOR STARTERS, TYPES "Z" AND "V."

are provided for the switch arms on all sizes, and all starters are provided with "off" open-circuit positions ; no-voltage release coils can be fitted if required. These starters control the rotor circuit of the motor only.

For controlling both rotor and stator circuits, the British Westinghouse Co. recommend the use of their oil-immersed starters, types "OV" and "OZ." We are informed that these starters are particularly suitable for use in fiery mines, textile mills, chemical works, damp situations, &c., and provide perfect protection against the ignition of inflammable gases and explosive dust. The above two types are made in the oil pattern for mining work.

An ammeter attachment can, if required, be fitted directly on to all the Westinghouse A.C. or D.C. motor starters. The normal full-load current of the machine is clearly indicated in red on the scale. Further information with reference to these starters can be obtained on application to the Supply Department of the company, Trafford Park, Manchester.

Switch Holder.

A simple and effective holder has been brought out by MESSRS HOGAN & WARDROP, of 2, Gresham Buildings, Basinghall Street, E.C. This holder, which they have named the chain-pull switch holder, is equally suitable for brackets, standards or electroliers, as it works in any position. The holder is worked by a neat ball

FIG. 7.—CHAIN-PULL SWITCH HOLDER.

chain, which operates a double-break rotary switch ; the operation of pulling the chain switches on, and the same action repeated turns the light off. At the same time the pull is so slight that there is no shock to metal-filament lamps. The length of chain can be varied to suit any conditions, with the result that there is a handy light at any height. Wall switches can be dispensed with, and the advantage of this to the æsthetic consumer will be fully understood by contractors.

Leonard Patent Lighting Strip.

MESSRS. W. LEONARD & CO., of 4, Soho Street, Oxford Street, W., have placed on the market a new type of lighting strip, suitable and intended for Coronation or other illumination purposes.

The holder is of neat design, and is provided with a fixing plate attached to the base, which can be turned into any suitable position. No staples are required, and the holders carry the wires, in contradistinction to the arrangement frequently adopted.

The stock strip has holders mounted at 12-in. intervals. Type A (which we illustrate) is a bayonet holder mounted on a twin cable ; Type B, a similar holder on a single cable ; and Type C comprises

FIG. 6.—LEONARD PATENT LIGHTING STRIP

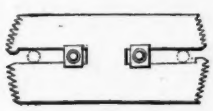
Edison screw-holders mounted on either twin or two single cables. The company is getting out a scheme for hiring and fixing, &c., the strip for the Coronation illuminations.

Festoon Lampholder.

With further reference to this lampholder, supplied by MR. E. C. SEEAR, of 16, Devonshire Square, E.C., and mentioned on page 216 last week, we understand that the holder is supplied in two sizes—one suitable for wiring with 1/18 twin, in lengths of, say, 30 holders, and the other for wiring with 7/22 twin in 60-holder lengths. There is a porcelain bridge in the centre of the interior, dividing the cable, and raised porcelain to protect the cover from the terminals, with insulating paper in the cover. With the 7/22 size there is no necessity to break the cable to connect to the holder, there being a special terminal to grip the connector ; therefore there would be no support required for the length, as there is no pull on the terminals and no joint in the cable.

A New Wall Attachment for Fittings.

MESSRS. HARTMANN & BRAUN have recently introduced a new spring-clip for use in fixing switches, plug sockets, wood blocks, &c., into walls and wall sockets. The device consists of a sheet-steel spring, as shown in figs. 8 and 9. The serrated edges of this spring grip the sides of the wall socket or recess firmly when the spring *b* is extended by turning the screws *c*.



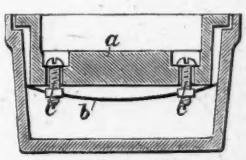


FIG. 8.—SPRING CLIP. FIG. 9.—SECTION OF WALL BOX.

It will be seen that a simple and cleanly method of attachment results, and one which enables the switches and other fittings to be left out until the whole of the wiring is completed. This is especially convenient in connection with wiring under plaster, as

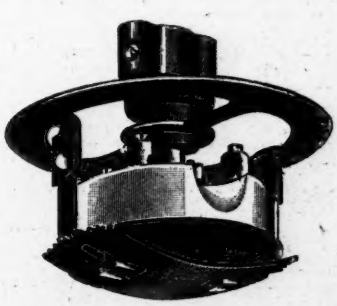


FIG. 10.—SWITCH FITTED WITH SPRING CLIP

the whole of the builders' work in the room can be completed before the fittings are placed in position, and risk of damage is thus avoided. When the switch or other fitting has no projecting rim

to fix its position in the socket, an artificial rim of sheet metal, of the form shown in fig. 10, can be attached.

Switches intended for back connections have a porcelain piece inserted between the spring and the switch base, which keeps the wire clear of the spring.

For attaching covers to wall boxes a similar spring is used, but with only a single central screw.—*E.T.Z.*

BUSINESS NOTES.

Catalogues and Lists. — The British Thomson-Houston Co., Ltd., Rugby.—The following new lists in the company's standard form, size and style, have been issued: No. 266, B.T.-H. worm gears; 267, fusible cut-outs, porcelain handle type; 268, transformer for mining bells; 269, electric flat-irons; 270, continuous-current motors. All the lists are well illustrated, and prices and other tabulated data are given, as well as brief descriptive matter.

The Silica Syndicate, Ltd., 82, Hatton Garden, London, E.C.—Catalogue of 26 pages containing illustrations, brief particulars and prices of their transparent quartz glass apparatus for laboratory use. The descriptive notes appear in both English and French.

Messrs. Siemens Bros. & Co., Ltd., Caxton House, Westminster, S.W.—Several further publications are to hand, thus: Pamphlet No. A 513 dealing with the firm's luminous mine-shaft signalling (Rutherford's patent); catalogue 531, which is a new edition superseding No. 31, and devoted to fluid primary cells and batteries; also a supplement to 531 entitled "Neotherm copper oxide cells," in which a battery of the cells and a regenerating oven are illustrated.

We have received from Messrs. Callender's Cable and Construction Co., Ltd., of Hamilton House, an excellent photogravure, which we have promptly framed and hung, of H.M.S. *Thunderer*, which was recently launched, and in which the main electrical distribution has been entirely effected by means of Callender's cable and special boxes.

Mr. R. H. Smith, 3, Thirlmere Road, Streatham, London, S.W.—Circulars containing full particulars of the Schulz steel tube contrary flow economiser (as made for some years by Messrs. M. R. Schulz, Ltd., of Brunswick, for whom Mr. Smith is sole agent in Britain and the Colonies). We understand that the manufacture of this economiser in England is now being commenced.

For Sale.—The Burnley Electricity Department has for disposal a 150-I.H.P. horizontal compound engine, with condensing plant, driving a 90-KW. dynamo. Messrs. Wheatley Kirk, Price and Co. are offering for sale by tender the plant, goodwill, stock, patents, &c., of Cunnington & Harris, Ltd. See our advertisement pages in this issue.

Installation Contracts. — Messrs. Edwards and Armstrong, of Bristol, have just received the contract for the complete equipment of the new electric supply undertaking at Trowbridge. Considerable extensions are also to be carried out by them to the Chippenham company's works and mains. They are at present carrying out electrical installations in country houses at Ashford, in Shropshire, Withypool, in Devonshire, Epping, in Essex, and Ashchurch, in Gloucestershire.

Bankruptcy Proceedings.—Edward Surtees, electrician, King Street, South Shields.—Receiving order made February 6th on debtor's petition. First meeting February 18th; public examination, February 23rd; both at Newcastle-upon-Tyne.

Harold Bristow, plumber and electrician, Kingston-upon-Hull.—Trustee (G. H. Acheson) released December 19th, 1910.

Alan McAlpin, electrical engineer, Leicester.—Trustee (L. V. Wykes) released February 1st.

George Valentine Blenkhorn Barker (trading as George Barker), electrical engineer, Gledhow, Wood Grove, Roundhay, near Leeds, and John Street, Albert Street, Harrogate, Yorkshire.—The first meeting of creditors herein was fixed to be held last week at the Official Receiver's office, the Red House, Duncombe Place, York, but it was stated that the debtor had gone away, and no statement of affairs had been lodged. The matter was therefore left in the hands of the Official Receiver, who will act as trustee and administer the estate in the usual manner.

V. G. Burkitt, Bristol.—First meeting, February 22nd; public examination, March 3rd; both at Bristol.

W. Aubert, Jun., gas and electrical engineer, Harp Alley, St. Bride Street, E.C.—Trustee, L. B. Linnett, released January 27th.

River Plate.—The *Review of the River Plate* contains the following items:—

Two tenders have been received by the Municipality of Villa Maria for the electric lighting of that town.

The Santa Fé Municipality have accepted the tender of Messrs. A. Parcus & Co. for machinery for extension of the electric light station.

The electrification of the Santa Fé Tramways will commence in April, and the first section should be finished in 11 months.

Two Swedish engineers have arrived in Buenos Ayres in representation of two Stockholm telephone companies who are desirous of establishing telephonic communication throughout the Republic. They have been presented to the Postmaster-General and will shortly present plans, &c.

Book Notices.—We are informed that, owing to an alteration in the publications, papers read before the Physical Society of London in future will appear in general only in the *Proceedings* of the Society, and not in the *Philosophical Magazine*. The *Proceedings* and other publications are now obtainable by the public from the publishers to the Society, the *Electrician* Printing and Publishing Co., Ltd.

"The Development of the Telephone in Europe." By Herbert Laws Webb. London: Electrical Press, Ltd.

"The *Colliery Guardian* Review of the Coal Trade in 1910." London: *Colliery Guardian*. Price 6d. net.

"Science Abstracts." Vol. 14, Part 1. Sections A and B. January 31st, 1911. With Index to Vol. 13, Sections A and B. London: E. & F. N. Spon. Price 1s. 6d. net each.

"*Journal* of the American Society of Mechanical Engineers." Vol. 33, No. 2. February, 1911. Baltimore: The Society. Price $1.00.

"*Transactions* of the Illuminating Engineering Society." Vol. VI, No. 1. January, 1911. Easton, Pa.: The Society. Price 75 c.

"Fortschritte der Elektrotechnik." By Dr. Karl Strecker. 1910. Berlin: Julius Springer. Price M. 10.

"Manuale dell' Ingegnere Elettricista." By Attilio Marro. 1911. Milan: Ulrico Hoepli. Price L. 8.50.

"The Engineer's Year Book of Engineering Formulæ, Rules, Tables, Data and Memoranda." By H. R. Kempe. 1911. London: Crosby, Lockwood & Son. Price 10s. 6d.

"Universal Electrical Directory, 1911 (J. A. Berly's)." London: H. Alabaster, Gatehouse & Co. Price 14s. 6d.

"Telegraphen und Fernsprechkabelanlagen." By C. Stille. 1911. Brunswick: Vieweg & Son. Price M. 12.

Metropolitan Tramways Map.—Mr. Edward Stanford, of Long Acre, W.C., has just issued a revised map of metropolitan railways, tramways and miscellaneous improvements, deposited at the L.C.C., November 30th, 1910, for the session 1911. The map is the same size as previous issues, scale 1 in. to the mile, and serves as a key to the various plans connected with the proposals. Price 2s. 6d.

Electric Driving of Looms.—An important development of the application of electricity to the textile trade has just occurred in Lancashire. Messrs. Frears, Lord & Brother, as already mentioned in our pages, are building a new weaving shed at Darcy Lever, which is to be electrically equipped throughout. A large amount of thought was given as to whether the shed was to be steam or electrically driven, and electric drive was decided on. The next point for decision was whether the shed was to be driven on the group system or individual drive employed. The order for 519 ½-H.P. and 175 ¾-H.P. high-efficiency loom motors was finally placed with Messrs. Siemens Bros. Dynamo Works, Ltd. Three-phase current at a periodicity of 50 cycles and a pressure of 200 volts will be supplied by the Lancashire Electric Power Co., who will provide a sub-station for the purpose of transforming their extra-high-pressure supply down to the required pressure. This is the first individual loom drive of such large size in this country, though it is extensively adopted on the Continent, where the firm of Siemens alone have supplied over 13,000 motors for the purpose. The individual driving of looms gives a very considerably increased output, and a much better quality of cloth. The bigger and more complicated the loom is, the better are the results that individual electric driving shows. Other advantages accruing are that, through the absence of all shafting and belting, the light is much better, and in the construction of the shed a large amount of money can be saved. Messrs. Siemens Bros. Dynamo Works are also supplying the switchboard, and the wiring will be carried out with their material, making use of their well-known "Zed" fuses and distribution boards.

Trade Announcements.—Messrs. Simplex Conduits, Ltd., have purchased the electrical fittings and art metal business which has been carried on during several years by Messrs. Jesson, Birkett & Co., Ltd., at St. Dunstan Works, Birmingham, and 9, Newman Street, Oxford Street, London. The business is now incorporated with that of Simplex Conduits, Ltd., and the manufacture of electrical fixtures in the modern and other styles will be carried on entirely at the Simplex Works in Garrison Lane, Birmingham, where an up-to-date plant is now in process of installation. The services of Mr. T. Birkett (late managing director of Jesson, Birkett & Co., Ltd.) have been retained, and he will conduct this department of the business in future. Considerable attention will be paid to the development of electrical signs. The various showrooms at the company's depôts will undergo reconstruction in order to be able to deal with the new business.

The makers of the "Brimsdown" (colloid-tungsten) metallic-filament electric lamps have their sales and publicity departments at Kingsway House, London, W.C. Owing to a rapidly increasing business, the Imperial Lamp Works have been compelled to extend their offices at Kingsway House, where they have taken over the whole of an additional suite; this extension includes the entire range of offices included in one side of the second floor. It was only about the middle of last year that the Imperial Lamp Works (Brimsdown), Ltd., acquired their original office at Kingsway House.

The Western Electric Co., Ltd., have opened branch offices as follows, where their representatives will give personal attention to all inquiries for cables, telephones and electrical supplies: King's Court, 115, Colmore Row, Birmingham; Standard Buildings, City Square, Leeds; 2, Bank Buildings, St. Mary Street, Cardiff.

With reference to the recent announcement that Messrs. Davidson and Blackadder, of 50, Wellington Street, Glasgow, had been appointed sole agents for them for the South of Scotland, the Reason Manufacturing Co., Ltd., ask us to state that they have extended this appointment to cover the whole of Scotland.

The Lewisham Hippodrome.—The order for the complete electrical equipment of this theatre, which was opened on Friday last, was obtained by MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., who sublet the wiring work to Messrs. G. E. Taylor and Co., of Bush Lane, E.C. The equipment is on similar lines to the Palladium, with dimmer, &c., as described in our issue of January 20th, but, of course, on a smaller scale. The A.C. supply is obtained from the South Metropolitan Electric Light and Power Co., and is employed throughout for the incandescent lamps, but Messrs. Siemens have provided two motor-generator sets for supplying current to the stage arcs, biograph room, and the various motors, fans, &c. The safety curtain is operated by an electric motor. Two mercury vapour-lamps are fitted into a cupola on the top of the building, and 2⁰ flame arc lamps on brackets are fixed round the sides and front of the buildings visible from the main road. As steel-conduits on the front of the stonework were inadmissible, "Stannos" wires have been run along the copings and painted to match, so that they are invisible from below. "Stannos" wires have also been used for the incandescent fittings in an arcade, and for a large part of the interior wiring.

Electric Supply Publicity.—We have received a further batch of publicity matter from the Electric Supply Publicity Committee, Moorgate Court, E.C., consisting of well-printed and concisely-worded leaflets dealing with a variety of topics appropriate to the present time. Among these we may particularise three leaflets, which should be especially useful in combatting the misleading statements so frequently circulated by the gas interests, viz., *Gas v. Electricity*, which draws attention to the always unhealthy and often dangerous fumes which are present where gas irons and stoves, particularly flueless gas stoves, are used; *Electric versus Gas Light, &c.*, showing in a simple manner the poisonous constituents of gas before and after burning, and the purity of electric light; *Electric Light and Safety*, showing the dangers of explosion accompanying the use of gas. Several leaflets deal briefly with the use of electricity by different tradesmen; one draws attention to the reduction in cost of modern house wiring; another, to the testimony in favour of electric light, by the Moorfields Eye Hospital, &c.; while others touch on the electric radiator, Coronation illuminations, electric power, the necessity of installing electric lighting while spring cleaning is being done, &c. Picture postcards dealing with electric cooking and the radiator, are also included. All the above are suitable for enclosure with accounts, &c.

Catalogues Wanted for Brazil.—MR. E. M. O. SCOTT, electrical engineer of the Great Western Railway of Brazil, Caixo 114, Pernambuco, desires manufacturers of electrical machinery and accessories to forward copies of their catalogues to him.

Liquidation.—HOWE ELECTRICAL ENGINEERING CO., LTD.—A meeting of creditors is called for February 21st at the office of the liquidator, Mr. A. Thraves.

LIGHTING and POWER NOTES.

Acton.—At Monday night's meeting of the Electricity Committee, the accountant submitted a statement of the accounts for the nine months ended December 31st last, in comparison with the corresponding nine months in the previous year. He said the result was unsatisfactory on the face of it, the deficiency being £1,828, as against £1,170. The contributing factors to that were the decrease in street and shop lighting, the extra charges for loans, and the extra amount charged to the fund for salaries of the administrative staff. The total expenditure for the past nine months was £9,782, and the income £7,954. Whilst private lighting was gradually increasing, shop lighting was decreasing.

Councillor Schultess-Young, chairman of the Council, reported he had that day heard from the Metropolitan Electric Supply Co., Ltd., that it was its intention, if allowed to come to Acton, to institute the telephone system of charging. The company's Bill before Parliament for the transfer of the undertaking had not received any opposition by way of petition.

Brighton.—The electrical engineer, Mr. J. Christie, has recommended the T.C. to install a 300-KW. motor-generator set at the Southwick station, in order to meet the local demand for current.

Canada.—By the completion of a loop line connecting St. Mary's and London, the Hydro-Electric Commission obtains a double transmission circuit through all the municipalities from the Falls to the present terminus of the Commission's main line.

Chile.—According to *Commercial Intelligence*, a company has asked for permission to establish a 10,000-H.P. plant on the outlet of Lake Llanguihue near Puerto Montt, to supply power to wood pulp factories.

Continental Notes.—SWEDEN.—A considerable increase in the number of waterfalls utilised for industrial purposes in Sweden, took place in 1910, as is shown by the fact that 21 new hydro-electric works were completed in the course of the year representing a total of 111,280 H.P. Among the new undertakings may be mentioned that of the Stora Kopparbergs Bergslags Aktiebolag amounting to 24,000 H.P. and that of the Sydsvenska Kraftaktiebolaget, comprising two stations of 10,000 H.P. The largest new works is the Trollhattan power station which could supply the whole of the province of Vestergotland and which furnishes 80,000 H.P., of which customers were obtained for 40,000 H.P. in 1909. At present seven large private works of an estimated capacity of 65,000 H.P. are in course of construction. In addition there is the power station at the Porjus falls in Lapland, which is to yield 50,000 H.P. for railway working and mining purposes.

BELGIUM.—With the title La Société d'Electricité de l'Ouest de la Belgique a company has just been formed in Brussels with a capital of £60,000, to acquire and work several concessions for electricity undertakings in the west of Belgium.

The Société des Charbonnages de Grand Conty et Spinois proposes to increase its capital to the extent of £40,000, for the purpose, among other things, of establishing an electrical power transmission plant in connection with its collieries.

AUSTRIA.—For the supply of the Tyrolean townships in the Isel and the Defereggen Valleys with electric light, a foreign company is, says *Elektrotechnik und Maschinenbau*, contemplating erecting a large generating station near Huben.

The T.C. of Krakan in Galicia has decided to spend 195,000 marks on enlargement of the existing station, including the acquisition of a new steam turbine of 750 KW. capacity.

HUNGARY.—The communes of Sarret and Korosladany have decided jointly to erect an electric generating station and purpose supplying, besides their own requirements, those of six neighbouring communes.

Crewe.—It is understood that the new County Training College and Hostel being erected just outside the town will be lit by electricity from the Corporation mains. The extension will make a supply of current available for the proposed new Garden City. The new postal sorting office being built in Weston Lane is also to be supplied with current by the Corporation.

Dundee.—Electrical motive power continues to progress on Tay side. Motors have recently been installed throughout a large brewery, and have displaced gas engines in two other establishments during the past week. The training ship H.M.S. *Unicorn* is at present being fitted for electric light, also a large block of tenement buildings, which is being wired on the O.S. system; both will be supplied by the Corporation.

Durham.—An important installation of electric winding has been made at the Lumley Third Pit of the Lambton Collieries, County Durham. At the pit, developments are being made, and a complete installation of electric power is being established, the current being drawn from the mains of the County of Durham Electric Power Distribution Co. A new sub-station is supplied at a pressure of 20,000 volts, reduced to 5,750 volts, at which it is taken to a three-phase motor-generator for supplying a winding engine of the Siemens-Halske type.

At Elemore Pit of the Hetton Coal Co., electrically-driven haulage gear has been put down, the current being supplied by the County of Durham Electric Power Distribution Co. The motor is of 100-H.P., of the Westinghouse type, working at a pressure of 440 volts. An air-compressor, driven by a 200-H.P. Lahmeyer motor has also been installed.

Edinburgh.—The Corporation has been granted permission to proceed with the erection of cooling towers at Dewar Place electric station.

Formby.—The Council has obtained an electric lighting order, and is negotiating with private interests with a view to their carrying out a scheme for electric supply.

Glasgow.—To evade fogs and generally purify the atmosphere, a Smoke Abatement League was recently formed under the auspices of the T.C., and on the suggestion of the honorary president (Lord Provost M'Innes Shaw), copies of a circular are now being distributed among occupiers of warehouses, offices, &c., over a wide area in the centre of the city. The circular points out that absence of smoke from the atmosphere would render fogs comparatively harmless, and the public are invited to consider the advisability of substituting for coal fires a smokeless method of heating, such as is provided by gas or electricity. An invitation is extended to all interested to communicate with the managers of the electricity or gas departments, who would show what apparatus would suit the several circumstances and submit estimates of costs, &c.

In connection with the forthcoming Scottish National Exhibition, it was proposed by the T.C.'s Electricity Committee that arrangements be made for a joint exhibit by the T.C.'s department, and the manufacturers of electric appliances, electric contractors and others. It has now been decided to abandon the proposal "in respect of the inadequate support it had received from electrical manufacturers and contractors."

Grantown.—The T. C. cannot make up its mind as to whether electricity or petrol gas should be adopted for lighting. At the monthly meeting Provost Barclay said he had no feeling apart from getting the best and the cheapest light. The issue had narrowed itself down to whether expert advice should be obtained; whether, after the expert's report, the light should be introduced by the Council or by a company; and whether petrol gas or electric light should be the system adopted. It was agreed, after considerable discussion, to have the advice of an expert.

Gravesend.—The T.C. has decided to make arrangements with contractors providing for the wiring and fitting of houses, the payment by the tenant to be spread over a term of years through the medium of a slot meter.

Haydock.—The U.D.C. has received from Messrs. Richard Evans & Co., Ltd., an offer to supply energy in bulk delivered to premises adjoining the Council offices at 2d. per unit. The whole matter is being considered by a Sub-Committee.

Horsham.—The B. of G. has appointed a Committee to consider the advisability of adopting E.L. for the workhouse. The electrical engineer to the U.D.C. has been in communication with the board on the subject.

Hounslow.—At the last meeting of the Heston and Isleworth Education Committee, the surveyor reported with regard to the lighting of certain schools, that, although the capital outlay for gas (£111) was considerably less than that for electric light (£171), the total cost per annum (£74 0s. 7d.) was considerably more than that for electric light (£37 2s.). The Sub-Committee, who had gone into the matter, recommended that electric light be installed at Hounslow Town and Grove Road schools, and also in the Isleworth Blue Boys' School, provided that the managers of the latter agreed to refund to the Committee a proportion of the cost.

India.—According to *Indian Engineering*, a project is on foot for the construction of a hydro-electric plant in Sikkim, where, by harnessing the Teesta River, it would be possible to distribute electricity over a radius of 100 miles, including the Darjeeling, Kurseong and Terai districts, and Dooars. The tea planters in the area are said to be favourably disposed towards the scheme, and it is proposed to give them a fixed rate per maund of tea.

The Darjeeling Municipality has called for tenders for the new installation to be erected at Berrick of 1,000 KW., to be increased later to 2,500 KW.

On Wednesday, last week, the foundation-stone of the hydro-electric works at Lonavala Tatas was laid by Sir George Clarke. The scheme—generally known as the Tata scheme—will supply the Bombay cotton industry with power.

Kettering.—Acting on the advice of Messrs. Kennedy and Jenkin, the U.D.C. has decided to apply to the L.G.B. for a loan of £13,100 for the installation of additional plant at the electricity works.

Llangollen.—A curious state of affairs was recently disclosed at a Council meeting, when for several hours discussion took place on certain payments to the electric light company, in which half the members were interested as shareholders or directors, and supported the payment, while the other half, all shareholders or directors in the local gas company, opposed the payment. In view of the deadlock, the chairman declared the meeting at an end.

London.—Hampstead.—At the meeting of the Council on February 9th, it was reported that the receipts for the three months ended December 31st last was £23,557, as compared with £24,027 in the corresponding period of the previous year. The remaining 429 incandescent gas lamps in the borough are to be converted into incandescent electric lamps. The cost is estimated at £3,009.

Poplar.—The electrical engineer has submitted a report on provision for future demands. The maximum demand reached 2,800 KW. in 1908-9, 3,420 KW. in 1909-10, and 3,680 KW. for the current year. It is anticipated the future demand will be as follows: 1911-12, 4,120 KW.; 1912-13, 4,560 KW.; 1913-14, 5,000 KW. The rated capacity of the present plant is 4,200 KW., and the agreement with Stepney B.C. provides for a stand-by supply of 1,000 KW. during next winter, when the Council's plant will be fully loaded; and it may be necessary to take in addition a bulk supply. In 1912-13, the engineer is of opinion it will be necessary to take 400 to 500 KW. from Stepney; that this is the limit to which a bulk supply can be profitably taken, and it will be necessary to make provision by extension of the present buildings and plant to meet the demand in 1913-14 at the Council's generating station. To meet next winter's load, it is suggested the existing small boilers be replaced by one large boiler, and it is also reported to be necessary for extensive alterations to be made in the supply system at Orchard Place to meet the increased demand for power in that neighbourhood. The Electricity Committee deferred consideration of the question of provision for future requirements pending a further report by the engineer.

Hammersmith.—The B.C. has agreed to accept the Curtis turbo-alternator, which the makers recently reconstructed with a view to improving it and increasing its output, on condition that the makers forego the extra price of the alterations, as the extra output has not been obtained.

Loughborough.—The scheme submitted by the electrical engineer for the conversion of the street lighting posts on the line of the electric cables, from gas to electricity, has come before the T.C., and it has been decided to recommend the Committee to arrange for the conversion. A letter was received from the electrical engineer suggesting that the Corporation bowling green should be lighted by electricity, so that play could be continued after dark. The Council, however, decided that this arrangement could not be carried out.

Newcastle-on-Tyne.—The Newcastle-upon-Tyne Electric Supply Co. has applied to the B. of T. for consent to the placing of extra-H.T. overhead lines in the Tynemouth R.D., Cramlington U.D., Wallsend Borough, Earsdon U.D., Weetslade U.D., and Seghill U.D. of Northumberland. The whole of the lines will be placed on private lands by wayleaves arranged with the owners, except where the lines cross public roads.

Newport (Mon.).—The Electricity and Tramways Committee of the T.C. has recommended that a showroom for the display of fittings and appliances should be provided, and the stores and offices concentrated; with this object it is proposed to utilise premises in Clarence Place, and in order to carry out the scheme, a loan of £2,000 is to be applied for.

Reeth.—The ratepayers of Reeth, Swaledale, have decided to have the parish lighted by electricity, with lamps of a total candle-power of 1,050, at an annual cost of £20. These will replace oil lamps of 210 C.P., which cost a similar sum. Current will be supplied from an old flour mill, which is being converted into an electricity station by Mr. Burton, of Askrigg. The agreement is for five years.

St. Margaret's-at-Cliffe.—The Dover T.C. has decided to apply for a loan of £1,500 to enable a supply of electricity to be taken to St. Margaret's by means of overhead wires.

Torquay.—At a meeting of the B.C. recently, Mr. E. T. Blackler, proposing the adoption of the Electric Light Committee's report, said the past year had been a very successful one, 1,477,000 units being sold, an increase of nearly 50,000 units as compared with the previous year. There was every reason to believe that the next year would be even better. The showroom had been opened, and this would prove a link between the supply and the consumer.

Walthamstow.—Mr. H. R. Hooper on February 9th held a L.G.B. inquiry into the application of the U.D.C. for a loan of £11,338 for electricity purposes, £1,838 being for mains, house services, &c., and the balance for plant. There was no opposition.

Watford.—The U.D.C. has received from the B. of T. an order enabling it to supply energy in the Hascot Wood district. As mains have been laid, current will be supplied forthwith.

TRAMWAY and RAILWAY NOTES.

Ayr.—The T.C. has again had under consideration the question of extending the tramway system to Hawkhill. A petition was submitted from residents in the district arguing that the extension was required, and that it would add to the prosperity of the town. It was, however, decided, by 9 votes to 8, not to proceed with the extension.

Birmingham.—The T.C. has decided to borrow £32,000 for tramway purposes, £13,500 being for the completion of the depôt at Kyott's Lake Road, £14,000 for the reconstruction of a portion of the Bristol Road system, and £4,500 for street widenings.

Brigg.—The R.D.C. has decided to raise no objection to an extension of three years for the lengthening of the North Lindsey Light Railway from Winteringham to Barton.

Cheshire.—The Bill which is being promoted in Parliament for powers to run railless electric trolley vehicles in Macclesfield and district, is to be vigorously opposed by the County Council on the ground that it would mean the introduction of a new form of traffic likely to injuriously affect the main roads and bridges.

Continental Notes.—Germany.—The T.C. of Düsseldorf is contemplating expending 1,190,000 marks on new rolling stock, and 610,000 marks on permanent way material for extensions of the existing municipal electric tramway network.

Trials are now being made on the electrified section of the main line between Dessau and Bitterfeld of two of the new electric locomotives built by Siemens-Schuckertwerk. The fast trains run made 350 tons, and the speed attained was 100 kil. per hour. The journey, in which the Minister of Public Works and the head of the State Railway Department took part, was performed very satisfactorily, and showed that electrical working was capable of fulfilling all requirements. Trials with electric locomotives of other makers are to be made in the near future.—*Elektrotechnische Zeitschrift.*

Austria.—The municipal authorities of Agram in Crotia have decided to electrify the existing tramway system. The current will be supplied from a station to be built, and the T.C. is now considering tenders submitted by the firms of Ganz & Co., Buda-Pesth, and the A.E.G.-Union Electric Co., of Vienna.

Bavaria.—The Minister of Communications has presented to the Parliament a statement of the various schemes for the electrification of the State railways. The projected lines have a total length of 363·6 kilometres, and comprise the following:—Salzburg-Bad Reichenhall-Berchtesgaden, 40·5 km.; Garmisch-Partenkirchen-Scharnitz, 24·5 km.; Garmisch-Partenkirchen-Griesen, 15 km.; München-Garmisch-Partenkirchen, 145 km.; München-Gauting, 18·9 km.; and München-Bad Tolz-Schlirsee-Holzkirchen-Rosenheim, 119·7 km.

Denmark.—It is reported from Copenhagen that a syndicate of Danish, Swedish and English financial firms has resolved to take over the proposed electric railway between Randers and Aarhus, in

the event of the concession sought for being granted. It is intended to entrust the construction of the railway to an English company, whilst the electrical equipment will be furnished by the Allmanna Svenska Elektriska Aktiebolaget. The power for working the line will be supplied from a station using either coal or peat as fuel for steam-raising purposes. The syndicate includes the Danske Landmannsbank, the Hypothik-og-Vekselbank, of Copenhagen, and M. Wallenberg, of the Enskilda Bank of Stockholm.

Doncaster—Bentley.—The Doncaster R.D.C. has received from the Light Railway Commissioners a notice to the effect that they propose to make an order authorising the extension of the tramways from Doncaster to the new colliery at Bentley.

Elland.—The U.D.C. is urging the Huddersfield Tramways Committee to extend its tramways to Elland Town Hall, and has offered to grant a subsidy of £100 a year for a term of five years, providing the extension from Holly Bank, Egerton, to the Elland Town Hall is not a paying route before the expiration of that period. A similar offer was rejected by the Halifax Corporation a short time ago.

Glasgow.—An indication of the general working of the two-stage fare experiment introduced recently in Glasgow has been given by Bailie Russell, convener of the Corporation's Tramways Committee. He pointed out that the experiment was not going to make the serious encroachment on the revenue which was estimated beforehand, as it was found that, to a certain extent, the reduction in the fares was producing new traffic. The number of two-stage tickets sold (*i.e.*, coupon or transfer tickets of four stages for 1½d.) exceeded to a considerable extent the falling off in the 1d. tickets, and also in the ½d. tickets, the explanation being that a great many people who formerly had only used the car for the ½d. distance, were now taking advantage of the two-stage fares. There was, however, a good deal of dishonesty and trickery in connection with the new fares, and they were trying to stop these practices. If these were stopped it was quite possible that the two-stage fares would be continued. The two-stage system was explained in the REVIEW a few weeks ago.

Huddersfield.—The Borough Treasurer has presented to the Tramways Committee the financial statement for the nine months ended December 31st last. It showed a capital outlay to date of £408,326. The miles run were 1,540,571, compared with 1,538,498 for the corresponding period of the previous year. The income was £72,993, or 11·37d. per car-mile, against £68,316, or 10·65d. per car-mile. The income was made up as follows :—Passengers, £70,246 ; postmen, £225 ; parcels, £970 ; advertising, £900 ; coal haulage, £647 ; sundries, £5. The working expenditure was £41,087, or 6·40d. per car-mile, against £37,217, or 5·80d. per car-mile, leaving a gross surplus of £31,906, or 4·97d., against £31,099, or 4·85d. After providing £17,947 (against £18,283) for the rent of Linthwaite lines, interest on capital and redemption of debt, and £9,187 for depreciation, there remained a net surplus of £4,772, or ·74d., against £3,629, or ·57d. On the reserve or renewals account there was a balance brought forward of £28,896, interest on investment amounted to £691, and the transfer for the nine months was £9,187, a total of £38,775. The payments were £31,999, leaving a fund of £6,776.

Lincoln.—The extension eastwards of the local tramways is contemplated. An agitation is on foot for the running of cars on Sunday afternoons.

Little Hulton.—Certain agreements as to amendments having been come to, the Little Hulton D.C. is withdrawing its opposition to the South Lancashire Tramways Co.'s Bill. Other local authorities are, it is understood, also withdrawing their opposition.

London-Brighton.—According to the *Daily Express*, the main line of the Brighton Co. is being surveyed by the consulting engineers of the company, as a preliminary to an electrical scheme being submitted to the board of directors. The routes dealt with are to Brighton, Worthing and Newhaven *via* Lewes, and a power station is suggested at Newhaven.

Matlock.—The U.D.C. will not oppose the Matlock, Matlock Bath and Cromford Railless Traction Bill. The voting was equal on the matter, and the chairman declined to give a casting vote.

Milnrow.—The D.C. has decided to send a protest to the Rochdale Corporation against the delay which is contemplated in constructing the Milnrow tramways, and stating that the D.C. was relying on the Corporation's promise to commence the work in the early part of the year.

Morley.—Application is to be made to the L.G.B. for sanction to borrow £22,600 for extending the tramways to Morley. In connection with the proposed extension an inquiry will be held by the Light Railway Commissioners at Morley Town Hall, on the 24th inst.

Portrush.—The proposed extension of the Giant's Causeway and Portrush Electric Tramway was the subject of discussion at the monthly meeting of the U.C. last week, the draft order being submitted by the promoters with a view to obtaining their approval. Mr. W. A. Traill was examined, and explained that the scheme of extension would consist of three short branches, the first one connecting with the main line about 300 yards below the depôt on the Rushmills Road, and continuing along the Croonamuck Road to the "Dry Arch." The second one would run from the Hotel Metropole to the railway station, and the third would be a continuation of the first line from the "Dry Arch" until it joined the harbour railway opposite the Golf Hotel. It was pointed out by Mr. Leech that the primary object in view in extending the line was to provide a means for conveying road metal to the harbour for shipment, this material being now conveyed by road, to the detriment of its surface, and to meet an increased passenger traffic.

Radcliffe.—The District Council has decided to oppose the South Lancashire Tramways Bill, which is to come before Parliament this session. The Council has been informed that some of the clauses might adversely affect Radcliffe.

Ripley.—The D.C. has decided to oppose the Notts and Derbyshire Tramway Co.'s Bill, although according to Mr. E. J. Ellis Fermor, the chairman, the Council is not averse to the tramways coming into the township ; it wishes to secure the insertion of certain clauses in the Bill for the protection of its interests.

South Africa.—There has recently been considerable friction between the employés of the Johannesburg tramways and the Committee, owing to the alleged arbitrary conduct of one of the inspectors. This culminated on Saturday, January 21st, in a general strike of motormen and conductors to the number of 321. The terms of the men were the dismissal of the obnoxious inspector, and after protracted negotiations, the Tramways Committee agreed to the demand of the employés, and the car service was resumed about 1 p.m. Subsequently, it was rumoured that the inspector would be given a position in the power station under Prof. Dobson, and the men have drafted a letter to the Committee stating that if this be done there will be a further strike. The drivers, conductors, and men of the power, lighting and maintenance departments, have formed themselves into an industrial union. Motormen and conductors are paid between 1s. 2d. and 1s. 6d. an hour, but many of them get a higher rate, and the average wage works out at over £20 per month.

Stretford.—The question of constructing a tramway from Stretford to Croft Bank, *via* Lostock Road, is to be considered by the Manchester Corporation, which is seeking to renew the Bill, originally granted to the Southern Tramways Co., authorising the laying of a tramway between Stretford and Barton, *via* Davyhulme.

Swinton.—The Swinton and Pendlebury Council, on Monday night, adopted a resolution opposing the Bill which is being promoted by the South Lancashire Tramways Co. to alter the existing provisions requiring them within certain hours to carry the labouring classes at cheap fares, and to increase the minimum fare from a halfpenny to a penny, and to amend other provisions.

U.S.A.—For some years the question of electrifying the railways in and near Boston, Mass., has been under consideration. In February, 1910, a joint board reported on the matter to the Legislature, which in turn obtained reports from the railways. These, briefly, estimated for the 461 single-track miles of the New York, New Haven and Hartford, and the Boston and Maine Railway, which is leased to the former, a cost of $32,751,000, including generating stations and locomotives using a single-phase A.C. system at 11,000 volts. The Boston and Albany Railway, estimated for a direct-current third-rail system at 1,200 volts, covering 128 miles, $7,520,000. Mr. C. L. de Mauralt, writing in the *Railway Electrical Engineer*, considers the first estimate exaggerated, and by excluding the power station costs, and revising certain items suggests that $16,000,000 is nearer the mark, or about $35,000 per mile of track. The Albany figures, without the power station cost, amount to $32,500 per mile of track.

Walsall.—The Tramways Committee has decided that the net profit on the undertaking for last year, amounting to £3,889, shall be carried to the reserve fund, raising the total of that fund to £27,601.

Wolverhampton.—The Corporation Tramways Committee has decided to effect an insurance with the Ocean Accident and Guarantee Corporation, Ltd., covering the liability of the Corporation in respect of accidents caused through defects in the permanent way and contact boxes of the tramways, in limits of £500 for any one accident and a total of £1,000 for the year, to run concurrently with the existing insurance with the same company respecting tramcars, expiring on March 31st, 1913.

Worksop.—The U.D.C. has decided to take steps to try and induce the promoters of the trackless tramway scheme from Rotherham to Tickhill to extend the service to Worksop.

TELEGRAPH and TELEPHONE NOTES

Alaska.—The U.S. Navy Department proposes to establish two new wireless stations on the southern coast of Alaska, one at Unalaska and the other at Kodiak. The collier *Saturn* will leave the Mare Island Navy Yard, San Francisco, on May 1st, with the apparatus. The Navy Department also contemplates the erection of a wireless station on the Hawaiian Island of Oahu. An effort will then be made to establish wireless communication between Unalaska and the Hawaiian Islands.

Australia.—Underground trunk telephone lines between Adelaide and Port Adelaide are now in operation. The cable measures 8 miles 3,485 ft.; the length of wires is 2,700 miles 3,960 ft. The cable cost £4,663; and the laying of ducts, pipes and so on ran up to £2,273, with other expenses for works, amounting to £500.

Brazil.—Further particulars given by the *Board of Trade Journal* show that telegraph lines and strategic railways are to be constructed, and up to 500,000 milreis (currency) will be expended on the erection of telegraph lines for the purpose of inking up the Brazilian telegraphs with the neighbouring countries.

Canada.—A law recently enacted at Ottawa provides that every sea-going and coasting passenger ship of over 400 tons gross tonnage registered in Canada, and every sea-going and coasting freight ship having a gross tonnage of over 1,200 tons, shall be equipped with apparatus for wireless telegraphy. Failure to comply with the law subjects the offending owner to a fine ranging from $100 to $1,000, or to a term of imprisonment not exceeding 12 months, or both.—*Electrical World.*

A correspondent of the *Times*, under date February 13th, states that a Government Bill has been introduced in the House of Commons to amend the Telegraph Act. It provides that all vessels carrying more than 50 passengers must be equipped with wireless telegraph apparatus. It will be seen that this report differs from that of our American contemporary.

Telephone Conference. — Arrangements have been made from Glasgow for an important Conference to be held in the Westminster Palace Hotel, London, on Monday, February 27th, at noon, to discuss the telephone question. At 5 o'clock on the same day, Mr. Samuel, the Postmaster-General, will receive a deputation from the Conference. It is expected that the Conference will be attended by 250 delegates, representing 186 boroughs and urban districts of England and Scotland, together with nine county councils in Scotland, and delegates from the City of Belfast.

Russia.—The Russian Budget for 1911 includes credits for the construction and repair of telegraph and telephone lines amounting to 6,267,000 roubles, and for the provision of radio-telegraph apparatus on warships.—*Board of Trade Journal.*

CONTRACTS OPEN and CLOSED.

OPEN.

Acton.—February 28th. Supplies, for a year, for the U.D.C. Electricity Department. See "Official Notices" to-day.

Australia.—March 7th. Eleven sections of a branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 14th.—Installation of wireless telegraphy at Thursday Island and Papua, for the P.M.G. of Australia. See "Official Notices" December 23rd.

April 18th.—One common-battery switchboard, for the P.M.G.'s Department in Western Australia. See "Official Notices" Dec. 23rd.

March 7th.—10,000 telephone protectors, for the P.M.G.'s Department in Victoria. See "Official Notices" January 13th.

March 8th.—Measuring instruments for the P.M.G.'s Department in Queensland. See "Official Notices" January 20th.

April 4th.—10¾ miles of lead-covered cable, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

June 14th.—Switchboard, common-battery, multiple, for the P.M.G.'s Department in South Australia. See "Official Notices" February 3rd.

June 14th.—Branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" February 3rd.

Belfast.—February 27th. (*a*) Stores for a year, and (*b*) vulcanised bitumen cables for a year, for the Corporation Electricity Department. See "Official Notices" February 10th.

Brazil.—February 23rd. The Brazilian Ministry of Communications and Public Works in Rio de Janeiro is inviting tenders for the concession for the establishment and working of a telephone line between Rio de Janeiro and the capital of the State of St. Paul.

Belgium.—February 18th. Three electric cranes for the docks are required by the Société du Canal et des Installations Maritimes de Bruxelles, Rue du Canal 50, Brussels.

Conway.—March 3rd. Duplicating engine, pumps and gas-producing plant, and works in connection therewith, at Old Colwyn. Permission to see works by arrangement with Mr. L. John, Surveyor to R.D.C.

Croydon.—February 27th. Electric light sundries, &c., for the Mental Hospital, Werlingham for the T.C., for a year; Clerk of the Hospital.

March 6th.—Fuse and other boxes, meters, &c., lamp-posts and bracket arms, and feeder pillars, for the Borough Electricity Department. See "Official Notices" February 10th.

Dublin.—March 6th. 3,000-KW. turbo-alternator, condensing plant, boilers, stokers, steel chimney, pumps, piping, &c., for the Corporation. See "Official Notices" February 10th.

Dutch Indies.—The Government of the Dutch East Indies has just sent a deputation to Padang to investigate the measures necessary to develop the Ombilin colliery, near that town, which produced in 1909 over 400,000 tons of fuel, and supplies almost the whole of the requirements of the ships and railways of the colony. The chief necessity is the installation of powerful electric hoists to facilitate the rapid coaling of ships: German machinery offered some time ago for that purpose failed to receive the approval of the Colonial Government. One of the members of the deputation will shortly visit Europe for the purpose of getting into touch with manufacturers of this class of apparatus, and no doubt the important installation at Rothesay Dock, described in our issue of February 3rd, will be brought to his notice.

Edinburgh.—March 6th. Electric light installation for new Usher Hall, for the Corporation; Jas. A. Williamson, City Superintendent of Works, City Chambers, Edinburgh (returnable deposit of £2 2s.).

March 7th.—Two cooling towers, for the Dewar Place Corporation electricity supply station. See "Official Notices" to-day.

Germany.—April 3rd. The Prussian State Railway authorities at Siegen are inviting tenders for the supply and erection of a 25-ton electrically-operated crane.

Tenders are about to be invited by the municipal authorities of Zullichau (Brandenburg) for the extension of the central electric lighting station, at an estimated cost of £20,000.

Gloucester. — February 21st. (*a*) One 750-KW. D.C. high-speed turbo-generator, with condensing plant; (*b*) one 150-KW. motor-generator, with starting gear; (*c*) switchgear for (*a*) and (*b*), for the City Electricity Department. See "Official Notices" February 3rd.

Govan.—February 27th. One 500-KW. rotary converter, for the Burgh Electricity Department. See "Official Notices" to-day.

Grimsby.—February 20th. Continuous-current motors and starting panels, from ¼ to 15 H.P., for the Corporation Electricity Department. See "Official Notices" February 10th.

Halifax.—February 28th. One natural-draught chimney-type cooling tower, for the Corporation electricity works. See "Official Notices" to-day.

Heston and Isleworth.—March 1st. Supplies, for a year, for the U.D.C. Electricity Department. See "Official Notices" to-day.

Hornsey.—March 6th. Meters, cables, troughing, &c., and distribution, joint and fuse boxes, for the T.C. See "Official Notices" to-day.

Ilford.—February 28th. Supplies for a year, for the U.D.C. Electricity Department. See "Official Notices" to-day.

India.—March 9th. Four electrically-driven centrifugal pumps, for the Cossipore station of the Calcutta Electric Supply Co., Ltd. See "Official Notices" to-day.

Ipswich.—February 18th. Rubber-insulated wires for a year, for the Corporation Electricity Department. See "Official Notices" February 10th.

Leeds.—February 21st. Coal and stores for the City Electric Lighting Department. See "Official Notices" January 20th.

London.—ISLINGTON.—February 23rd. Electrical and engineers' stores, for the B.C. See "Official Notices" January 13th.

BERMONDSEY.—February 20th. Stores, for the borough electricity and destructor works. See "Official Notices" February 3rd.

MARYLEBONE.—March 1st. Supplies, for a year, for the B.C. Electricity Department. See "Official Notices" to-day.

FULHAM.—March 1st. Stores for a year, for the B.C. Electricity Department. See "Official Notices" to-day.

HAMMERSMITH.—March 8th. Water-tube boilers, with superheaters, forced draught furnace, with mechanical stokers, economisers, &c., for the B.C. See "Official Notices" to-day.

Manchester.—February 27th. General stores for the Corporation Tramways Department. See "Official Notices" February 10th.

Newport (Mon.).—March 7th. Electric light fittings, for the B. of G.; A. H. Rees, Clerk, Queen's Hill.

Portsmouth.—February 21st. Supplies, for a year, for the Corporation Tramways Committee. See "Official Notices" February 10th.

Rochdale.—February 21st. Electric wiring of Smith Street baths, for Baths Committee. Specification, &c., from Mr. C. C. Atchison, Electrical Engineer (deposit £1 1s.).

Russia.—The municipal authorities of Tambor have just invited tenders for the establishment of a central electric lighting station in the town.

Sale.—Supply of switchboard and crane, for the U.D.C. Specifications from Mr. Charles Hopkinson, M.I.C.E., 29, Princess Street, Manchester.

Turton.—February 20th. Bare copper overhead mains, poles, &c., for electric lighting in Bromley Cross area and Bradshaw Road, &c., for the U.D.C. See "Official Notices" January 20th.

Walthamstow.—February 24th. Stores for a year, for the U.D.C. Electricity and Tramways Departments. See "Official Notices" February 3rd.

Yarmouth.—90 uniforms for the staff, also tramway tickets for one year, for the T.C.

CLOSED.

Aberdeen.—Mr. J. S. Pirie has secured the contract for installing electric light in John Knox parish church, Aberdeen.

Bradford.—The Corporation Tramways Committee recommends that the chairman, deputy-chairman, and the general manager be authorised to arrange with Dr. Zani, of Milan, for the supply of a "Filovia" trackless trolley vehicle, at £667. The Committee recommends the acceptance of the tender of Messrs. McLellan & Co., Glasgow, for the purchase of old steel tramway rails, at £643; the tender of Messrs. A. G. Barrett & Co., for the supply of iron castings required for tramway construction work, at £42; and the acceptance of the offer of Edgar Allen & Co., Ltd., for manganese-steel crossings required at the Bankfoot car depôt, at £88. The Committee has also approved a resolution authorising the purchase of three portable electric drills from the Consolidated Pneumatic Tool Co., at £34.

Carnarvon.—The T.C. has accepted the offer of the National Electric Construction Co., Ltd., for the improvement and extension of the battery, and has decided to apply for a loan of £600 for the work.

London.—The Metropolitan Asylums Board has accepted the tender of W. J. Fryer & Co., at £34, for the supply of electric cable for the X-ray apparatus, &c., at the Children's Infirmary.

L.C.C.—The Highways Committee received the following tenders for the provision of new and the alteration of existing switchgear, and the provision of transformers at the Camberwell, Elephant and Castle, Holborn, New Cross and Wandsworth sub-stations, and 23, Belvedere Road:—

Johnson & Phillips, Ltd.	(recommended)	£7,056
Electric Construction Co., Ltd.		7,324
British Westinghouse Electric and Mfg. Co.		7,885
General Electric Co., Ltd.		7,975
Electric and Ordnance Accessories Co., Ltd.		8,491
Ferranti, Ltd.		8,610
A. Reyrolle & Co., Ltd.		8,846

Estimate of chief officer, £6,200.

For the electric wiring and fittings, &c., for the Wandsworth fire station, a L.C.C. committee received tenders as follows:—

A. Hawkins & Sons	(recommended)	£157
Malcolm & Allan, Ltd.		174
W. J. Fryer & Co.		190

Engineer's estimate, £180.

HAMMERSMITH.—The B.C. Electricity Committee received 13 tenders for supplying one 3,000-KW. turbo-alternator and condenser:—

Name.	Price.	Type of turbine.	Maker of alternator.	Type of condenser.
	£			
Willans & Robinson	7,938	Impulse and reaction	Siemens	Surface with augmentor
Richardsons, Westgarth and Co.	7,942	Impulse and reaction	Siemens	Contraflo with kinetic pumps
Brush Electrical Eng. Co.	8,052	Parsons parallel flow and reaction	Brush	Surface
J. Musgrave & Co. ..	8,081	Zoelly	Siemens	Quiggin's dripless surface
British Westinghouse Co.	8,400	Rateau	Westinghouse	Surface with Leblanc air-pump
J. Howden & Co. ..	8,490	Zoelly	Siemens	Allen's surface
Escher Wyss	8,528	Zoelly	Siemens	Surface with Leblanc air-pump
C. A. Parsons & Co..	8,831	Impulse and reaction	Parsons	Surface with augmentor
Belliss & Morcom ..	8,885	Impulse	Siemens	Morcom surface
Machinenfabrik Oerlikon	9,068	Impulse	Oerlikon	Worthington surface
Fraser & Chalmers ..	9,420	Rateau	Siemens	Worthington surface
British Thomson-Houston	9,664	Impulse	Thomson Houston	Worthington surface
General Electric Co.	10,801	Zoelly	General Electric	Quiggin's dripless surface

The engineer reported as follows:—

Only one offer has been received for machines of exactly similar type to the last installed—*i.e.*, the Brush Electrical Co.; all other contractors offering machines of a later type, embodying improvements which experience has proved to be of advantage. The two lowest tenders received are for machines of the impulse and reaction type, and, as proof of the satisfactory operation of this type of machine, I am informed that Messrs. Brown, Boveri & Co., the Continental friends of Messrs. Richardsons, Westgarth & Co., have a large number of this type of machine in operation, and a total of 180 on order, ranging from 15,000 KW. Provided that the order is promptly placed, all firms, with the exception of the General Electric Co., can deliver the plant and have it working by the time stated—viz., September 1st, 1911.

The engineer described to the Committee the several advantages of the proposals submitted by Messrs. Willans & Robinson and Messrs. Richardsons, Westgarth & Co. respectively, and the Committee came to the conclusion that the scheme suggested by Messrs. Richardsons, Westgarth & Co. was the more favourable one. The several similar contracts carried out for the Council by this company in the past had given every satisfaction. They therefore recommended that the tender of Messrs. Richardsons, Westgarth and Co., at £7,942, be accepted.

The following tenders were received for the supply of 8,180 yards of extra-high-tension cable:—

	Amount.	Manufactured at
A. Grenier & Co.	£2,656	Gare, Switzerland.
Union Cable Co., Ltd.	2,783	Berlin.
Western Electric Co., Ltd.	2,920	Woolwich.
Johnson & Phillips	2,977	Charlton.
British Insulated and Helsby Cables, Ltd.	2,979	Prescot.
Siemens Bros. & Co., Ltd.	2,991	Woolwich.
W. T. Glover & Co., Ltd.	3,000	Manchester.
Craigpark Electric Cable Co., Ltd. ..	3,025	Glasgow.
W. T. Henley's, &c., Ltd.	3,033	Woolwich.
Callender's Cable, &c., Co.	3,038	Erith.
Standard Cable Manufacturing Co. ..	3,061	Not stated.
R. R. Todd	3,081	Cologne.
General Electric Co.	3,262	Not stated.

It has been the Council's practice hitherto to purchase cable made in this country, on account of the easy access thereby offered to the contractor's workshops for testing purposes, and for other reasons in connection with the satisfactory performance of the contract, and the Committee were of opinion that the practice should be followed in this case. They therefore recommended that the tender of the Western Electric Co. be accepted, subject to the cable being made in this country.

Messrs. Cowans, Ltd., are to supply 20 additional switch-panels at £16 6s. each.

The Premier Accumulator Co., Ltd., are to maintain, repair and renew the station battery for 10 years at £45 per annum.

Four three-phase transformers are again to be hired, but of greater capacity than in previous years, for the Shepherd's Bush Exhibition, at £135 for the year.

South Africa.—According to the *British and S. African Export Gazette*, an order for a two-phase 3,000-KW. turbo-alternator with condensing plant, switchgear and cable connections, has been placed with home makers by Messrs. Reunert & Lenz on behalf of the Johannesburg Municipality. A contract for the supply of cable and tail-end boxes, for the Johannesburg Gas and Electric Supply Department, has been secured by Messrs. Henley's (South Africa) Telegraph Works Co., Ltd.

Stretford.—The U.D.C. has accepted the tender of the Tudor Accumulator Co. for the maintenance of a battery for 10 years, at £127 per annum, subject to no charge being made for the first year.

Walsall.—The Corporation Electricity Committee has accepted the following tenders:—

Richardsons, Westgarth & Co., Ltd.—Two 500-KW. turbo-generators, £5,822.
H. Gough & Son, Wolverhampton.—Alterations to the generating station £1,150.
J. Spencer, Wednesbury.—Pipework in connection with boiler house, £322.
Lee, Howe & Co., Tipton.—Vertical feed-pump, £75.
Electric Construction Co., Ltd.—A direct-current exciter with Belliss engine, £575.

Walthamstow.—The U.D.C. has provisionally accepted the tender of the Brush Electrical Engineering Co., Ltd., for a 1,000-KW. mixed-pressure turbine, with turbo-generators of 500 KW. each, and surface condenser and pipework, at £6,371.

Wolverhampton.—The Electricity Committee has accepted the tender of the British Electric Transformer Co., Ltd., at £450, for two 500-KW. transformers for the Chillington sub-station.

Yarmouth.—The T.C. has accepted an offer from Messrs. William Cory & Son, Ltd., for 600 to 700 tons of Scotch anthracite coal, at 10s. a ton f.o.b.; and the electrical engineer was directed to obtain tenders for 3,000 tons of Scotch anthracite coal and 5,000 tons of Midland fine slack coal.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

THE following orders are issued:—

Commanding Officer—COL. H. M. LEAF.

Monday, February 20th.—"A" Company. Technical drill, 7 to 10 p.m.
Tuesday, February 21st.—"B" Company. Technical drill, 7 to 10 p.m.
Thursday, February 23rd.—"C" Company. Technical drill, 7 to 10 p.m.
Friday, February 24th.—"D" Company. Recruits' infantry drill, 6.30 7.15 p.m. Technical drill, 7.15 to 10 p.m.
Saturday, February 25th.—Week-end run at Sheerness. Parade at Victoria Station at 1.10 and 4 p.m. respectively. Dress: Service dress with great coat; waist-belt and haversack to be worn outside of great coat.

(Signed) P. H. CAMPBELL, Capt. R.E., Adjutant.

FORTHCOMING EVENTS.

Institution of Civil Engineers (Students).—Mr. Swinburne's lectures on "The Uses of Chemistry in Engineering" have been postponed to March 24th and 31st.

Institution of Electrical Engineers (Newcastle Local Section).—Friday, February 17th. At 7 p.m. At Tilley's. Annual dinner.

London Chamber of Commerce.—Friday, February 17th. At 2.30 p.m. At the Chamber, Oxford Court, Cannon Street, E.C. Address by Mr. H. Laws Webb, M.I.E.E., on "A 'Telephone Authority' for Great Britain (an Alternative to State Monopoly)."

Institution of Electrical Engineers (Glasgow Local Section).—Friday, February 17th. At 8 p.m. At the Glasgow Technical College. Meeting of the Students' Section.

Institution of Electrical Engineers (Newcastle Local Section).—Monday, February 20th. At 7.30 p.m. At the Armstrong College, Newcastle. Paper on "The Relation between Displacement and Load in Alternators," by Mr. W. Firth; and demonstration of "Firedamp Cut-Out Apparatus," by Mr. G. Ralph.

Electro-Harmonic Society.—Tuesday, February 21st. At 8 p.m. Ladies' night. See "Notes," below.

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, February 21st. At 7.30 p.m. At the Municipal School of Technology, Manchester. Paper on "Sub-station Practice," by Messrs. O. Welch and A. E. Dent.

Institution of Electrical Engineers.—Thursday, February 23rd. At 8 p.m. Adjourned discussion on papers on "Long-Distance Transmission of Electrical Energy" and "Extra-High-Pressure Transmission Lines."

Association of Mining Electrical Engineers (Inc.) (South Wales Branch).—Saturday, February 25th. At 5 p.m. At the Park Hotel, Cardiff. Papers on "Oil for Transformers and Switches," by Mr. G. W. Humphry; and "Three-Phase Motors for Haulage in Mines," by Mr. Jas. Simpson.

Manchester Association of Engineers.—Saturday, February 25th. At 7.30 p.m. At the Grand Hotel, Manchester. Paper on "Large Gas Engines," by Mr. A. E. Chorlton.

Association of Engineers-in-Charge.—Saturday, February 25th. At 3 p.m. Visit to the Surrey Commercial Docks, Rotherhithe, S.E.

NOTES.

Holborn Street Lighting.—At the meeting of the B.C. on February 8th, the Works and General Purposes Committee reported that, on July 27th last, they submitted to the Council an offer made by the Gas Light and Coke Co., to install and maintain an improved system of gas lighting in the public thoroughfares of the borough for £6,688 per annum (a total candle-power of 260,000 being guaranteed), provided that they were given a contract for 10 years. In October it was decided to invite the Gas Light and Coke Co., and the various electric light companies having powers of supply in the borough to give a public demonstration of the two different forms of lighting in Gower Street, in order that members might have an opportunity of comparing them in a street where there are no other sources of illumination than the street lamps. The Metropolitan Electric Supply Co., Ltd., conducted the electric light experiment on behalf of all three electric lighting companies. Tests of the lighting were taken photometrically at frequent intervals from December 20th to January 17th, with the result that the electric lamps were found to be giving an average of 395 C.P. each, and the gas lamps 318 C.P. This was the result from readings taken at certain specified angles, but on a further test being made at equal distances along the centre of the road, the illuminating effect was found to be about equal for both forms of lighting. The specification required that each lamp should give a minimum C.P. of 300. The companies were also invited to submit sealed tenders for lighting the borough according to a schedule of prices per annum for lamps of different C.P., ranging from 60 to 2,000 C.P. each. These tenders, which were considered by the Committee on January 26th, together with a report of a sub-committee thereon, are both for a 10 years' contract, subject to the Council having the option to determine at the end of the first five years, on payment of a proportion of the capital charges incurred. This sum is estimated at from £2,500 to £3,000, and would be agreed before the contract is executed. Each company undertakes to provide all services, lamps, columns, fittings, painting and attendance, together with the necessary supply of gas or electric current, for the inclusive prices quoted per lamp. The gas company do not quote a total sum for the whole of the lighting, but the Electric Lighting Co. estimate that for the total expenditure of £6,020 they would provide according to their schedule of prices a total C.P. of 390,000. The total C.P. of the existing lamps is 140,000, and the cost of lighting and maintenance for the year 1909-10, including all extras for foggy days, alterations, &c., was £7,102. To effect a satisfactory improvement of the lighting in all the streets, the Committee are of opinion that lamps of 2,000 C.P. should be provided in High Holborn and New Oxford Street, 600 C.P. in Tottenham Court Road, and 400 C.P. in the other main thoroughfares; in all the other streets 90 C.P. lamps would be sufficient. This scheme would necessitate a total C.P. of about 405,000, and, calculated on this basis, the annual cost would be as follows:—Electric light, £6,602; gas light, £7,527. These are outside figures, and it may be that, on further consideration of the details, a reduction of this total C.P., and the consequent expenditure may be effected, and that the amount provided in the estimate for the year 1911-12, viz., £7,400, may prove sufficient. The Committee were strongly of opinion that it is not advisable to have two different systems of lighting in the borough, and, having regard to all the circumstances, the difference of cost is not sufficiently great to warrant a radical alteration of the system of lighting on this ground alone; they recommended that the offer of the Gas Light and Coke Co. be accepted.

Alderman Max Clarke, the Chairman of the Committee, in moving the adoption of the report, argued that sufficient reason had not been shown for the Council to abandon gas lighting in Holborn when so many other boroughs in London had given up electric lighting after a trial and gone back to gas. Personally, he thought Holborn sufficiently well-lighted. (Cries of "No, no.")

Councillor Motion moved as an amendment that the tender of the electric company be accepted. The adoption of electric lighting would, he said, save the ratepayers £925 a year, which in the course of 10 years at 4 per cent. interest, would mean a saving of £11,000 or £12,000. His experience was that at present Holborn was the worst lighted of any of the metropolitan boroughs. ("No, no.")

Alderman Glave seconded the amendment, saying they had invited tenders and were in honesty bound to accept the lowest. If the Committee did not want two different systems of lighting in the borough, as they now said, why did they invite tenders from the electric companies? He had been a member of the Council since its formation, and he had never known a case where a tender 15 per cent. lower than another was rejected, provided it came from a respectable firm.

Councillor Reid said that the matter was referred back to the Committee on the first occasion to ascertain if the electric lighting people could give them a light equal to gas at the same price. The electric light company had gone to considerable trouble and expense in the matter to demonstrate that they could do so. Moreover, the Council had had a deputation from a number of ratepayers asking for electric light instead of gas, even if the electric light cost more. It was an insult to the Council and to the electric light company after what had been done to ask them to pass the resolution brought forward that evening.

Councillor Michelson moved that the whole matter be referred back to the Committee for information as to the boroughs that had given up electricity for gas.

Alderman Dibdin strongly supported the Committee. He did not believe that there was any real difference in the results obtained from either gas or electricity.

Alderman Max Clarke said the electric company undertook to convert the existing standards free of charge, but their estimate did not include the provision of any new posts, and these were essential to the Council's scheme. If it was decided to raise the posts as high as those in Gower Street the Council would have to pay; if the posts were left as at present, which was what the company suggested, there would be nothing to pay. As far as High Holborn, Holborn and Oxford Street were concerned, it was proposed by the electric company to light these streets with arc lamps of about 2,000 C.P., and that would cost exactly the same whether they got the light from the gas or the electric companies, for the standards were to be provided by either company and were included in the estimate.

A vote was then taken on an amendment to refer the report back, and was carried *nem. con.*, it being understood that the Committee will bring the matter up again in a month's time.

The Limerick Appointment.—We make the following extracts from the comments of the *Irish Builder and Engineer* on our recent criticism of the action of the Limerick Council:—"The English technical journals appear to be somewhat incensed at the recent action of the Limerick Council in appointing a gentleman from Galway as borough electrical engineer, and are sarcastically commenting on the proceedings with a view possibly of warning others than Irishmen from submitting themselves for similar Irish posts in the future. . . . . We do not propose to discuss the vexed question as to whether public appointments in Ireland should be confined to our fellow-countrymen, or whether some knowledge of the Irish language should be weighed in the balance against practical efficiency. Most certainly, however, advertisements should be so worded in cases where such ideas may prevail, so that non-Irishmen will not be tempted to waste time and money in fruitless applications. Our City Councils do not gain respect by such occurrences as are reported to have happened in Limerick, and the most insular must feel that the cutting comments in British journals on the incident have some measure of justification."

Electro-Harmonic Society.—The next concert (ladies' night) will be held at the Holborn Restaurant (King's Hall), on Tuesday evening next, February 21st, at 8 o'clock. Mr. J. H. Rosenthal will preside. The programme is as follows:—Vocalists, Miss Alice Baxter, Miss Ethel Bevans, Mr. Denis O'Neil, and Mr. F. Franklin Clive; solo violoncello, Mr. W. H. Squire; impressions of plantation life, Miss Clara Alexander; prestidigitateur, Mr. Wallace Galvin; songs and stories at the piano, Mr. Tom Clare; solo pianoforte and accompanist, Mr. William Every, F.R.C.O., L.R.A.M.

Dundee Electricity Department.—The members of the Corporation electricity department held their annual supper and smoking concert last Wednesday week, when practically the whole staff, over 140 in number, were present. Convener Nairn, who presided, congratulated Mr. Richardson, the engineer, on the splendid way in which the recent work of reconstruction had been carried out. A long and varied concert programme was gone through.

Accident.—An employé of the Clyde Valley Electric Power Co. named Arthur Johnstone was severely injured in the arms through contact with a live wire in Messrs. Mechan & Sons' shipyard at Scotstoun. He was removed to the Western Infirmary and detained.

West Ham Electricity Staff Salaries.—Upon the recommendation of the electrical engineer of West Ham, the following increases of salary are to be granted: Mr. H. Hart, private arc superintendent, present salary 35s. per week and commission, future 45s. and commission, rising to 50s. at the end of 12 months; Mr. J. Turtle, wiring superintendent, present salary 40s. and commission, future salary 50s. and commission. On and after April 1st next the following will be the remuneration for lighting canvassers: 35s. per week and commission, rising at the end of 12 months' satisfactory service to 40s. and commission; power canvassers, 40s. per week with commission, rising at the end of 12 months' satisfactory service to 45s. and commission. The salary of Mr. A. J. Rogers, sales order clerk, is to be increased from 25s. to 30s. per week. The commencing wage of private arc attendants is to be fixed at 15s. per week, rising by half-yearly increments of 2s. 6d. to 25s. Various increases are to be made in the wages of the assistant firemen, banksmen and water attendants.

Tramcar Passenger Prosecuted.—At the Rawtenstall Police Court on 9th inst., the Corporation prosecuted a passenger of Bacup, for damaging a tramcar by striking a match on one of the panels. He admitted the offence, explaining that he did it unthinkingly. He offered to pay 5s. damage and costs, and on these terms the case was dismissed.

Collision and Fire.—Yet again a fatal collision has occurred, on a French railway, followed by fire due to the use of gas for lighting the trains. The frequent recurrence of these outbreaks of fire grows monotonous, but nothing is done by our authorities, at any rate, to put an end to the risk.

Sentence on an Electrician.—Before Mr. Justice Grantham, at the Liverpool Assizes on Friday, February 10th, Wm. Hy. Pike (59), an electrician, was sentenced to 12 months' imprisonment, with hard labour, for attempted arson at Liverpool on November 20th. Evidence showed that Pike, who had a shop in Commutation Row, was in financial difficulties, and in June took out policies of £300 in respect of household goods and £300 for shop furniture and fittings.

Institution and Lecture Notes.—The Institute of Metals.—The next meeting of the Institute will be the second May lecture, which is to be delivered in London on Friday, May 12th, by Dr. G. T. Beilby, F.R.S., on "The Hard and Soft States in Metals." The Autumn meeting of the Institute will this year take place at Newcastle-on-Tyne, on September 20th and 21st. An influential local committee, of which the Hon. C. A. Parsons, C.B., F.R.S., is chairman, and Dr. J. T. Dunn honorary secretary, has been formed, and is making such arrangements that the success of the meeting is already assured. The names of senders of approved forms of application for membership received during February, March or April will be included in the ballot list to be issued in connection with the May lecture. Such candidates for membership, if duly elected, will have the privilege of 14 months' membership in exchange for their first subscription, including an extra volume of the *Journal* of the Institute of Metals.

Institution of Electrical Engineers (Yorkshire Local Section).—On Friday last the members of the Yorkshire Local Section dined together at the Hotel Metropole, Leeds. A company of over 100 persons sat down. The chair was occupied by Mr. T. Harding Churton. The loyal toasts having been honoured, Mr. Robert Hammond proposed "The City and Trade of Leeds." Referring to the Leeds Electricity Works and his early connection with the installation, he was glad to say that the record costs with which they started had been sustained most admirably by the indefatigable secretary of the Section, Mr. H. Dickinson. These low costs would bear comparison with any other steam-driven works in the world. The £1,400,000 expended on the tramway undertaking was doing exceeding good service and was of considerable benefit to the city and trades. The electric tramway system was comparable with any electric tramway in the world. The greatest works in Leeds at the present time were drawing their supply of power from the works of the Leeds Corporation. The Lord Mayor (Mr. W. Middlebrook, M.P.) in responding, thanked Mr. Hammond for his kind remarks, and said the secret of the financial prosperity of the works was to be found in the scientific knowledge of the man at the head and in the able management. The development of electricity in recent years made him wonder what electricians had yet in store for them. He had heard that this winter had been more free from the fog fiend than any winter they had known for many years, and that one of the principal factors in the absence of the fog had been the increased use of electricity.

Alderman C. F. Tetley proposed "The Institution of Electrical Engineers." He said he was convinced, from what had taken place in the past, that there would be great discoveries in the future, and urged the necessity of a sound and thorough foundation before going on to practical work. No one could call himself an electrical engineer unless he had laid in early life wide and deep the foundation on which he intended to build in the future. Mr. S. Z. de Ferranti (President) in reply referred to the fact that it was just 30 years since he came to Leeds, with very little knowledge, to light up the main floor of the Crown Point Printing Works with four arc lamps run from one dynamo. He remembered how big that installation seemed to be to people who were accustomed to run one. There was no comparison between that day and the present; and electricity now was nothing compared with what it would be in the future, when electricity would fulfil all our wants. That had a great bearing upon the Institution; they must all do their best for the Institution and contribute all the available information they had for the purpose of enlightening others by furnishing interesting papers

Mr. S. Mavor, chairman of the Glasgow Local Section, proposing "The Yorkshire Local Section," said he was associated with the early beginnings of electric lighting in Leeds a quarter of a century ago, when the Town Hall was first lighted. Mr. T. Harding Churton (Chairman, Yorkshire Local Section), in responding, reminded them that their distinguished President was a member of the Section, and Sir Robert Hadfield also. Nothing had contributed more to the march of civilisation than the facilities which Science had afforded for communication. The telephone in other countries, under happier circumstances, had thriven and developed to a much greater extent than here, and he hoped it would not suffer by the transference of the system to the Government, but rather that increased facilities for the greater use of the telephone would be given, and that some of the ground that had been lost in the past would be regained under the new *régime*. In America, if one wished to call up a subscriber over a trunk line, no charge was made for the call until the individual wanted was ready to reply. The knowledge that one would not be obliged to pay for a useless call was a great inducement to make use of the telephone for long distances, and its field of usefulness was thereby greatly extended. He urged reduction in the price of energy for power, and said they were moving slowly in comparison with other countries. In Detroit, Michigan, there were turbine sets of 14,000 KW. capacity each, while the maximum load on the Leeds station was about 9,000 KW., which could be supplied from one boiler in the Detroit station.

Mr. Geo. Wilkinson submitted "The Electrical Industry and kindred Associations." He thought that this country had not taken its legitimate place in the electrical industry; those who thought that the electrical industry of Great Britain was an important business, ought to go to Germany and the States. He suggested that the Institution should institute entrance examinations with two grades of members, technical and scientific in one class, and commercial engineers in another class. Mr. Sydney D. Kitson, F.R.I.B.A., said he believed the pall of smoke could only be removed by the further use of electrical power in the industries. The architects were working hand in hand with the electrician.

Mr. Walter Emmott, past chairman of the Yorkshire Local Section, proposed "Our Guests," and Alderman F. Kinder responded.

During the evening Mr. R. S. Kitchen's orchestra rendered pleasing selections, and Mr. Richard Wilson contributed a number of songs most acceptably.

Junior Institution of Engineers.—The 27th annual dinner of this Institution was held on Saturday last at the Hotel Cecil, the president, Sir J. J. Thomson, occupying the chair. After the loyal toasts, that of "Physical Research" was proposed by Lord Justice Fletcher Moulton. Engineers, he said, had to look at questions from a practical point of view, yet they would all loyally join in this toast, remembering that the laboratory experiments of to-day were the engineering achievements of to-morrow. In his early days he believed in the reality of force and matter. Then law prevailed. Now even the lawlessness of the Institution's President was profound. Already one great family, radium, was in the Divorce Court, and future ages might be regaled with still greater scandals. In his reply, Sir J. J. Thomson said the difficulties of physical research were very great. Newton, Faraday, Clerk Maxwell and others, working simply to satisfy their own curiosity and with no idea of monetary gain, had brought about far-reaching changes. Twenty-five years ago he knew of no scholarships for such pioneer research men, but now it was perhaps more difficult to produce the men than the scholarships. Our modern education was too complex. We had too many examinations, and too little independent thought. His experience went to show that the student who absorbed with ease, also discharged with ease. We had not yet attained the high level of some other countries. He was in Berlin when the announcement was made that an association for the promotion of research had been formed, under the patronage of the Kaiser, with a capital of half a million sterling.

Dr. John Perry, in proposing the toast of "Engineering Progress," spoke of the great value of the work of the practical engineer in devising means for the performance of the laborious work of the world. In response, Mr. Alexander Siemens showed that the progress of physical research during the last half century was largely due to the engineer placing the means of intercommunication so freely at its disposal.

Mr. S. Z. de Ferranti gave the toast of the "Junior Institution of Engineers." He said that, in his opinion, the last Patents Act had done a great deal of harm. The compulsory working clause was detrimental to progress. Its beneficial element could have been secured with less harm to the patentees. There were many good patents which could not profitably be worked in all countries, the business not being sufficiently large. The length of time also for which a patent was granted was not long enough. Certain processes required a whole series of patents, and these often extended over a number of years; by the time the final stage was reached the original patents were running out. This made it difficult to get money for big progressive schemes. Mr. Dunbar Kilburn, the vice-chairman of the Institution, in responding, referred to its increased membership, and to the valuable services of its secretary, Mr. Walter T. Dunn.

The toast of "The President" was proposed by Mr. W. A. Tookey, and enthusiastically received. Sir J. J. Thomson briefly replied.

An excellent musical programme was provided during the evening under the direction of Mr. Richard Cooper.

Institution of Electrical Engineers (Birmingham).—The fourth annual dinner of the Birmingham Local Section was held at the Grand Hotel, Birmingham, on Wednesday, January 18th; Mr. M. Railing (chairman of the Section) presided, Mr. S. Z. de Ferranti (president) having been accidentally prevented from attending.

The toast of "The Institution of Electrical Engineers" was pro-

posed by the chairman, who, referring to his election, said he felt that it was mainly due to a feeling amongst the members that in the Midlands recognition ought to be given to the manufacturing side of their profession. After all, the manufacturing side found employment for the men who were trained in science by their colleges and universities. The Midlands were, indeed, the centre of the electrical industry, and the gigantic works, though not represented collectively by one name, or governed by one board, were works which could hold their own in comparison with those of any other country. Amongst the works in that district they had those of Siemens Bros. at Stafford, the Electrical Construction Co. at Wolverhampton, the British Thomson-Houston Co. at Rugby, and their own colony at Witton. In that manufacturing and commercial centre, it was of the utmost importance to all concerned that every effort should be made not only to hold their position but also to gain a real supremacy. He urged that their central organisation in London should endeavour to strengthen the ties binding it to its sister organisations in the provinces, advocated "efficiency" as the watchword of their profession and their Institution, and reminded them of the great manufacturing and commercial opportunities Britain held as the centre of a world-wide empire. Whatever advantages they enjoyed from Great Britain's position, they would not be able to hold their own unless they were as well equipped as their competitors. Major W. A. J. O'Meara, C.M.G., responded to the toast, and said that they need not be ashamed of their profession; on the contrary, seeing how electricity now pervaded every department of life and activity, they had every reason to be proud of it. Unfortunately, people in general, while enjoying the benefits of what engineers did, did not show the appreciation those benefits deserved. He thought the time had arrived when engineers and, not least, electrical engineers should assert themselves and let it be known how much they were contributing to the progress of civilisation.

Mr. H. Hirst proposed "The Birmingham Local Section," describing it as one of the most successful and brilliant in the country. There was no doubt that Birmingham industries, apart from the electrical industry, were prospering and were increasingly requiring to have electricity at their disposal. Mr. A. M. Taylor, in responding, said that the Local Section was founded about 10 years ago and had now 399 members. They must not lose heart because the electrical industry in some departments was just now in a bad way. There was no doubt that when the Greater Birmingham scheme came into force it would itself provide a large amount of work in the electrical trades.

The toast of "Electrical Industries" and "Our Guests" was proposed by Mr. R. K. Morcom, who referred to the keen competition in the electrical industries as involving a perpetual struggle between virtue and necessity. It was going a little too far to guarantee figures which meant 103 per cent. efficiency, but he had met with such a case. There were firms ready to accept or offer any sort of guarantee, and to discover a way of complying with it afterwards. Mr. C. H. Wordingham and Mr. T. Harding Churton responded to the toast.

Mr. Solomon (G.E.C. Carbon Works, Witton) proposed the health of the chairman, who briefly responded.

During the dinner several excellent selections were given by the G.E.C. Orchestral Band from the Witton Works, and after the conclusion of the toast list the proceedings took the form of a social concert, the programme including songs by Mr. Howard Foulds and other gentlemen.

On February 8th a paper was read by Mr. L. F. Mountfort on "The Electrical Undertaking of the Birmingham Tame and Rea District Drainage Board."

Institution of Electrical Engineers (Glasgow Section).—At the meeting on Tuesday, Prof. Baily, Edinburgh, read a paper on "Some Considerations Relating to the Parallel Working of Alternators." The paper should have been contributed at the December meeting by Mr. James R. Barr, the author, but was postponed owing to that gentleman's death.

On Saturday last, the 11th inst., the members held their annual smoking concert in the banqueting hall of the Grosvenor Restaurant, Glasgow: Mr. Sam Mavor, the chairman of the Section, presided, and a most enjoyable evening was spent.

Institution of Municipal Engineers.—The arrangements for holding examinations in municipal engineering have now been completed. A strong board of examiners has been formed, including the following gentlemen associated with electrical engineering:—Messrs. H. C. Adams, H. Boot, J. E. Edgcome, E. Manville, and Capt. H. R. Sankey. The examinations are not merely for entrance into the Institution, but are open to anyone, and the whole of the arrangements are subject to the sole discretion of the examining board; the examinations will be thoroughly practical, and candidates will be allowed to use any text-books they choose, just as if they were employed in their own offices. Electrical and mechanical engineering will form the subject of one of the papers. A diploma in municipal engineering will be granted to successful candidates. The scheme appears to be both admirable and unique.

Association of Mining Electrical Engineers (West of Scotland Branch).—A meeting was held in Glasgow on Friday evening, at which Mr. James R. Benson read a paper on "Compressed Air *v.* Electricity for Mining Purposes."

Mr. Robert Hammond will begin a course of lectures to the Senior Students of Faraday House on Tuesday, February 21st, upon "Electricity Undertakings."

Onewatt Lamps.—We regret that on page 218 of our last issue, we referred to the candle-power of these lamps as having been extended up to 100—we should have said 400.

L.C.C. and Wages and Hours of Labour of Electrical Fitters.—Representations have been made to the L.C.C. by the Electrical Trades Union that the list of rates of wages and hours of labour prepared under Standing Order No. 263 should be amended, so far as it relates to electrical trades, by increasing the rates of wages of workmen of certain trades and by the insertion of the trades of "plumber jointer" and "electrical fitter." The Council's list is based on the rates of wages and hours of labour recognised by associations of employers and trade unions and in practice obtaining in London, and the Committee who have been considering the matter report that they are of opinion that the information supplied by the union and the information obtained by the Committee's direction with regard to the rates of wages in practice obtaining in London does not justify any alteration of the rates of wages in the list, nor the inclusion in the list of the trade of "electrical fitter." They consider, however, that the trade of "plumber jointer," with a rate of wages of 11d. per hour, should be inserted in the list, and recommend—

That the list of rates of wages and hours of labour be amended by the insertion therein, under the heading of "Electrical trade," of an item as follows:—

Plumber-jointer: 11d. per hour; 56 hours per week. Overtime: First two hours, time and a quarter; second two hours, time and a half; after four hours until starting time next day, and Sunday, double time.

Electric Furnaces.—The Canadian Government has for some years been investigating the subject of smelting iron ore by means of electricity, and the latest result of this investigation have been recently published in a bulletin issued by the Department of Mines. When the investigation was first started in 1904 there were in existence but four electric furnaces for the smelting or handling of iron ore. In 1910 there were 114 furnaces, of which 67 were in operation, 11 not working, and 36 in course of construction. Of these furnaces 30 were in Germany, 23 in France, 12 in Italy, 10 in Austria and 10 in the United States. Seventy-seven of them were of the arc type, 55 were induction furnaces, and two a combination of arc and resistance furnaces. A great increase in the output rating of the furnaces is noted, the largest at present in operation having a rated output of 15 metric tons per day.—*Electrical World.*

Another Slander.—Reporting the fire at the residence of the Earl of Crewe, the *Evening News* on Friday last stated that it "was due to an electric wire fusing." There were no two ways about it; the statement was positive and definite. The official report, however, published later, stated that the cause of the fire was unknown. As we have said elsewhere, prejudice dies hard where ignorance prevails, and we can only conclude that the reporter, being ignorant alike of the facts and the probabilities, keeps the stereotyped formula ready to drop in where he thinks it may possibly turn out correct. It is not fair.

Will.—The will of Sir J. Clifton Robinson, after confirming three settlements made during his lifetime in favour of Lady Robinson and his son, leaves as residue £13,641 gross. This, according to the *Times*, is left upon similar trusts to those of his principal estates included in the settlements.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—The Nuneaton T.C. has decided to increase the salary of the borough electrical engineer from £250 to £300 per annum, with five annual increments of £10.

At a meeting of the Falkirk T.C. on Monday night, the appointment of a burgh electrical engineer in place of Mr. John McMillan, resigned, was considered. Mr. Harold Ranson, of Falkirk, was recommended by the Electric Lighting Committee, and this was confirmed by the Council. Mr. Ranson is at present assistant electrical engineer to the Scottish Central Electric Power Co.

The Atherton (Lancs.) District Council have decided to increase the salary of their electrical engineer, Mr. C. T. Astbury, to £170 per annum.

Mr. E. G. Staygle, who has recently been appointed assistant electrical engineer to the Tonbridge U.D.C., has been voted a special grant of £10 10s. by the Oban T.C. in appreciation of the able manner in which he carried out his duties as interim burgh electrical engineer, to which post he was appointed in November last.

The Plymouth T.C. have decided to increase the salary of Mr. F. Haynes, the assistant electrical engineer, from £200 to £225 per annum.

Mr. G. Rigby has resigned his position as shift engineer at the Corporation electricity works, Stockton-on-Tees, and sails for British Columbia at the end of March.

Tramway Officials.—The L.C.C. General Purposes Committee has recommended, and the Council has agreed, that the salary of Mr. A. L. C. Fell, the chief officer of tramways, which was in 1908 increased to £1,750, be now advanced to £1,875, and at April, 1912, to £2,000.

Mr. W. G. Ritchie, assistant engineer of the Mexbro' and Swinton Tramways Co., who is leaving to become manager of a tramway company in Nova Scotia, has been presented by the staff and employés with a pair of field glasses.

A Buenos Ayres exchange states that Mr. Pedriali, general manager of the Anglo-Argentine Tramway Co., left last month for a short holiday in Europe.

General.—The following alterations in Post Office appointments were announced in the Press last week:—Mr. W. Slingo, superintending engineer G.P.O., has been appointed assistant engineer-in-chief; Mr. E. J. Eldridge and Mr. J. M. G. Trezise, first-class staff engineers; and Mr. T. Plummer, Mr. F. Tandy, and Mr. J. Sinnott, assistant superintending engineers, have been appointed superintending engineers. Mr. Eldridge will take charge of the Midland District, Mr. Trezise of the electric light department, Mr. Plummer of the North Wales District, Mr. Tandy of the South-Eastern District, and Mr. Sinnott of the North-Eastern District.

Mr. Thomas W. How has removed from No. 15 to more commodious offices at 17, Victoria Street, Westminster, S.W.

The marriage took place at Flempton on February 8th, of Mr. E. G. Barton, head electrician to Earl Cadogan, at Culford Hall, and Miss B. Bates.

Mr. J. W. McCrosky, manager of the operating department of Messrs. J. G. White & Co., Ltd., left on Wednesday, 15th inst., for a business trip in Venezuela and Brazil.

Mr. D. A. Storr, general manager of the Clyde Valley Power Co., left Glasgow on Tuesday, 14th inst., for Canada. The visit, which will extend some time, will combine business and pleasure.

The Hull Corporation Tramway employés on Monday presented a solid silver rose bowl on an ebony plinth to Ald. F. Larard, J.P., on his retirement from the chairmanship of the Tramways Committee, which he has held for over 12 years. Mrs. Larard was made the recipient of a standard lamp, with shade.

CITY NOTES.

Northampton Electric Light and Power Co., Ltd.

The directors' report for 1910 says that the company's progress continues to be marked by increasing success, as shown by the following figures:—Lamps and motors added (all reckoned as 32-watt lamps, being equivalent to the old standard of 8-c.p. carbon) 17,012, making a total equal to 107,351 lamps. The horse-power of motors added is 450, making a total of 1,713 h.p., and of this 1,430 are hired from the company. The mains added were 1 mile 704 yards in extent, making a total of 25 miles 195 yards, besides feeders added 2 miles 1,740 yards. The current sold for lighting and power had increased 40 per cent., the total units being 1,978,974, as against 1,481,790 in the previous year. The maximum load on plant was 1,276 kw. (33 per cent. increase), the load factor 17·7, as compared with 16·7 in the previous year, and the working costs per unit sold show 15 per cent. decrease. During the past year an additional battery room has been erected, also workshops and other buildings, and a new battery has been installed. There have been other important additions to the plant. To meet the increasing demand a new engine, dynamo, and boiler have been ordered for delivery this year. Further shares to the number of 15,000 (11,871 ordinary and 3,129 5 per cent. preference) have been taken up by existing members and their friends at a small premium. Immediately after the close of the year the 4 per cent. debentures, shown by the accounts, amounting to £40,750, were paid off, and thereupon new 4 per cent. debenture stock was issued at par for the total sum of £40,000. The depreciation account has been increased by £4,650 (out of which £80 has been written off on sale of feed water, £500 has been written off accumulators, £150 off demolished buildings, and £500 off mains), also £350 has been written off motors, and £700 added to reserve. The sum of £691 will be required for the dividend on the 5 per cent. preference shares, and the directors propose that 7 per cent. per annum should be paid on the ordinary shares for the half-year (making 6 per cent. for the year), requiring £1,901, leaving £1,572 to be carried forward.

National Electric Supply Co., Ltd.

Mr. J. Booth presided at the annual meeting held on 2nd inst. at Preston. He said that notwithstanding trade depression, the company had added 138 new consumers to their mains, and sold about 68,500 more units of electricity. This did not fully represent the business done, nor what was expected to be done, for the increased use of the metallic lamps by reducing the consumers' bills (in some cases to one-half) had prevented the expansion in the company's income for lighting. Nevertheless, there was shown an increase over last year of about £200 in gross revenue, as against a decrease of £1,200 last year from the year before from the use of the metallic lamps. Under these circumstances, the company might now claim to have turned the corner as regards income. Unfortunately, the rating authorities chose this time to largely increase the assessment, and although the company succeeded in getting their demand modified, they had to submit to an addition of over £700 a year, with the result that they were now paying in local rates alone more than 10 per cent. of their total income. In addition to this, the year's profits had been saddled with the costs incurred in arriving at a settlement, amounting to £114. Proceeding, the chairman said he never felt more hopeful of the future of the company. The staple trade of the district was improving and seemed likely to be good for some time to come, and with better trade, people would be more inclined to go to the expense of wiring their premises. The company had spent less than usual on capital account—£2,070, and that principally in extension of mains to get new customers, and rather more than usual in repairs and maintenance. Last year £4,400 was put to reserve for depreciation, but £200 of it was required for writing off meters. This year this was not required. It was proposed to take £4,200, and after paying 4s. a share, which, with the 3s. already paid, made 7s. a share to the ordinary shareholders, to carry forward £302.

National Telephone Co., Ltd.

The report of the directors for the half-year ending December 31st, 1910, to be presented at the meeting at Hamilton House, on February 23rd, shows that the income accrued in respect of the business of the half-year amounts to £1,744,111, as compared with £1,599,990 for the corresponding period of 1909, being an increase of £144,121. The working expenses amount to £1,015,443, as compared with £922,693 for the corresponding period of 1909, an increase of £92,750. The net result for the half-year (after deducting the Post Office Royalties amounting to £167,613) is a profit balance of £561,056, as compared with £523,441 for the corresponding period of 1909, an increase of £37,615. The rentals carried forward for unexpired terms of running contracts amount to £1,413,376, as compared with £1,324,916 at the corresponding period of 1909, an increase of £88,460. Out of the available balance of £430,841, shown by the net revenue account, the board recommend the payment for the half-year of a dividend at the rate of 6 per cent. per annum on the first and second preference shares, 5 per cent. per annum on the third preference shares, 6 per cent. per annum on the preferred stock, and 6 per cent. per annum on the deferred stock, less income-tax in all cases. The board also propose to transfer £200,000 to the reserve fund account, and to carry forward £12,091. The sum of £202,657 has been expended on capital account during the half-year in the erection of 14,324 additional exchange and private stations, and in the construction of underground works.

Complete Years ending December 31st.

	1908.	1909.	1910.
Income	£2,951,001	£3,149,126	£3,422,423
Less P.O. royalties	283,758	302,984	329,494
Net income	2,667,242	2,846,142	3,092,929
Working expenses	1,687,535	1,813,491	1,987,357
Net result for the year	979,707	1,032,651	1,105,572
Per cent. of working expenses to net income	63·27	63·72	64·25
Amount from previous year	£10,439	£10,339	£11,683
Debenture and other interest	247,307	273,807	292,664
Preference and other dividends	437,500	437,500	437,500
Carried to reserve fund	295,000	320,000	375,000
Carried forward	10,339	11,683	12,091
Rental carried forward for unexpired terms	1,245,351	1,324,916	1,413,576

Bath Electric Tramways, Ltd.—Sir James Sivewright presided on 10th inst. at the annual meeting held at Winchester House. The traffic receipts, and indeed all the business, showed improvement to the tune of £2,236, in spite of bad weather. Their motor-'buses were accessories to the tramway system, and were giving a satisfactory return. The tramways ran 14,060 miles more than in the previous year. The total profit was £14,822, after meeting operating and administration expenses. After paying debenture and preference interest, £6,696 remained to be carried forward. Though a dividend on the preferred ordinary had been earned, it was not declared because the £24,150 loan stood in the way. When they paid off that loan by issuing the further debentures, the preferred ordinary would have a dividend. The operating costs were 4·733d. per car-mile; including costs of administration they were 5·091d. The chairman said that in arranging their debenture issue, they hoped to be able to provide for their Saltford extension and certain other works. The report was adopted.

Telegraph Construction and Maintenance Co., Ltd.—Subject to audit the directors propose a dividend of 10 per cent. (£1 4s. per share), together with a bonus of 5 per cent. (12s. per share), in addition to the 5 per cent. already paid, making 20 per cent. for the year 1910.

Underground Electric Railways Co., of London, Ltd.—Interest on the income bonds for the half-year ended December 31st last at the rate of 1 per cent. per annum will be paid on March 1st.

South Metropolitan Electric Light and Power Co., Ltd.—The transfer books and register are closed from 15th to 28th inst. for the preparation of warrants for dividends payable 28th inst.

London Electric Supply Corporation, Ltd.—The report for 1910 shows a gross profit of £53,225 against £50,686. Debenture interest and 6 per cent. preference dividend are paid, £5,000 is placed to reserve, 2 per cent. is to be paid on the ordinary shares and £3,660 carried forward. Units sold increased by over 3 millions.

Para Electric Railways and Lighting Co., Ltd.—The directors have declared a dividend at the rate of 12 per cent. per annum for the half-year to November 30th upon the ordinary shares, making a total of 10 per cent. for the year.

Bank Rate Reduced.—The Bank Rate was yesterday reduced from 4 to 3½ per cent.

London United Tramways, Ltd.

THE directors' report for the year ending December 31st, 1910, states that the operation of the undertaking during that period resulted in gross receipts amounting to £333,659, and the working and general expenses, maintenance and repairs to £234,211, leaving, with the balance brought forward from last account, a net revenue of £100,398. After payment of interest on debenture stock and loans for the year, and providing for income-tax, there remains a balance of £30,814. The directors propose placing £30,000 to reserve for renewals and contingencies, and to carry £814 forward. With the amount now added the reserve will total £67,534. The gross receipts show an increase of £15,433, and the working expenses an increase of £7,645, resulting in a net increase of £7,788. The number of passengers carried during the year was 60,132,451, an increase of 3,254,890 over the number carried in the previous year. The directors report a substantial increase in the passenger earnings, although the traffic was adversely affected during a part of the year by the extensive repairs which were made in the permanent way. A new system of fares was inaugurated in May last. Each penny stage has been divided into three sections, passengers being permitted to travel over any three sections for a penny, four sections for three-halfpence, and five or six sections for twopence. This alteration has resulted in additional traffic. As forecasted by the directors in their last report, extensive repairs to the permanent way and rolling stock have been commenced, and considerable progress made during the year. Over 3,500 rail joints have been repaired by a special process of cast welding, and a number of crossing frogs and points replaced. Nearly the whole of the rolling stock has been passed through the repair shops for complete overhauling and renovation; a new system of chain grate stokers has been installed in the power station, and other improvements made to the plant. Alterations have been made to the workshops and stores at the Chiswick depôt, affording greater facilities for repairing the rolling stock and handling materials. The total cost of these improvements amounted to £19,242, of which £11,142 has been charged to the reserve for renewals and contingencies, the balance of £8,100 having been included with the ordinary expenditure on maintenance. Sixty cars have been equipped with covered tops, and an additional 40 cars will be similarly dealt with this year. A Bill promoted by the company in the last session of Parliament for an extension of time for the construction of the tramway along Kew Road, Richmond, received the approval of Parliament. The work has not yet been carried out, and the company has promoted a short Bill in the ensuing session of Parliament for a further extension of time for one year. The directors are not in a position at this time to make any report as to the negotiations now pending with the London County Council for the sale of the portion of the company's undertaking within the borough of Hammersmith. The directors record with great regret the death of Sir Clifton Robinson, late managing director and engineer.

Dublin and Lucan Electric Railway Co.

THE directors' report states that the gross receipts for the half-year ended December, 1910, were £4,007, being £240 in excess of those of the corresponding period of 1909. The expenditure increased by £131. After providing for debenture interest there is an available balance of £1,556, out of which the directors recommend the payment of the usual half-yearly dividend on the 5 per cent. preference shares; that £350 be applied towards the improvement of the scheme for supplying surplus electric current for lighting purposes to the public, which sum corresponds with the net profit derived from that source whilst in operation; that £200 be allocated towards expenditure on providing mechanical stokers, and an alternative feed water supply at the power station; and that the balance of £531 be carried forward to next half-year, as against £416 in the previous year. The directors express regret at the death of Mr. W. F. Clarke, who was identified with the company from its commencement.

St. James' and Pall Mall Electric Light Co., Ltd.

MR. WALTER LEAF (chairman) presided on Tuesday at the offices, Carnaby Street, W., over the twenty-third ordinary general meeting of the above company.

In moving the adoption of the report (see ELECTRICAL REVIEW, page 230), the CHAIRMAN first referred to the death of Col. Eustace J. A. Balfour, who was one of the original founders of the company, and was chairman from 1889 to 1908. In the early days of the company it was solely through the personal efforts of Col. Balfour that the company was saved from financial disaster. His courage and foresight were rewarded, for in a comparatively short time he had placed the undertaking on a firm and prosperous basis which was still maintained. As they would have seen, the year, if not a sensational one, was at least a profitable one, and that prosperity was reflected not merely in the maintenance of the dividend, but in the considerable sums they had been able to devote to the thorough maintenance and reorganisation of their plant, which was in the highest state of efficiency on the most modern standard. At the last meeting he told them they had entered into a provisional agreement with the London Electric Supply Corporation, who had equal rights with themselves in the area for an association such as that contemplated by the Electric (London) Supply Act, 1908. At that time the agreement was under the consideration of the Board of Trade, and they were able, after stringent inquiry, to satisfy the Board that the agreement was one which fully safeguarded the rights of consumers and was in the interests of the general public, and the Board accordingly approved of the agreement which was now completed. It was a long and complicated document, which he could not undertake to explain to a meeting like that, but its chief provisions were as follows:—They obtained control of the whole distribution of electricity within the district, purchasing the supply of alternating current from the London company at a fixed price for those customers who required it. They also paid the London company a rent for the use of their mains and their distributing plant within the district, further undertaking to set aside annually in the names of trustees for accumulation, such an amount as would guarantee to them the sum of £30,000 when the time for purchase came. In the meantime, they received the whole of the payments from the users of alternating current within the district. These payments were included in their revenue for the sale of electricity, and the charge for rent and the supply of current was added to the sum for the purchase of electricity. The business done by the London company in the area was small compared with their own, and the agreement would make little, if any, difference in the way of immediate profits; but the board were satisfied after a year's experience of working that the arrangement was a very valuable one for them, and they were happy to report that all the questions which inevitably must arise under such a complicated reorganisation of business had been settled in a manner satisfactory to both parties. Another important piece of work which had been carried out in the past year was the improvement of the Carnaby Street station, and the work foreshadowed a year ago was now nearly complete. A new set of boilers with mechanical stokers had been installed and was burning bituminous coal to the complete satisfaction of the engineers and to the material benefit of the costs of generation. There had been no smoke difficulty, and it was a matter for congratulation that they were now almost independent of the vicissitudes of the South Wales coal market. They had also completed the new buildings in Marshall Street and housed the department, which was before somewhat imperfectly housed in hired premises. They, at the same time, had been able to supply better accommodation for the working staff, which was very highly appreciated by them. The cost of scrapping the boilers and other plant superseded had been £10,431. This had been covered by the appropriation of £8,500 from the contingency fund and a special transfer of £1,931 from the revenue of the year, and little or nothing remained to be done under this head. But at Mason's Yard, which they converted from a generating to a transforming station, the work was not yet completed, and here further scrapping would have to be accounted for in the current year. They had, therefore, transferred a further £4,000 from the revenue to the contingency fund, partly to meet this and partly to provide for further contingencies, such as obsolescence of other plant, which were none the less likely to confront them because, for the moment, they could not be foreseen. The figures of the revenue account were not susceptible of comparison with those of last year, as they were abnormally swollen by 18 months' supplies to the London company's customers. They showed, on the whole, an increase of revenue of £12,104, and the cost of current purchased was £9,920. The final result of the year's working was an addition of £3,462 to the balance carried to net revenue account, and this was almost entirely due to the more economical working of the plant both at Carnaby Street and at the central station, and reflected the highest credit on the engineer and staff. Had their revenue not been swollen by this abnormal addition, it would have shown a decrease of £1,100. They would remember that the board expected such a decrease, and, indeed, thought there would also be a fall in 1911. Although the first part of their anticipations had been fulfilled, there seemed ground for hoping that they might prove wrong in the last, for the whole loss of revenue took place in the two first quarters of 1910, and the last two showed a slight tendency to recover. This tendency had been emphasised during the six weeks of 1911, and they were, therefore, hopeful to see an end of the long period of falling revenue, due to the metallic-filament lamp, and that 12 months hence the natural growth of business would be reflected in their accounts. They had still a large field for development in their wealthy, although small area, and quite recently had added two important customers in the Palladium Theatre and the Royal Automobile Club. In conclusion, the chairman explained the figure of £1,470 set aside under the head of "Reserve for contingent liability under agreement with the London Electric Supply Corporation, Ltd.," which represented 1½ year's sum set aside to secure the London company £30,000 at the time of purchase. In the future £980 per annum would be set aside.

SIR JOHN MORRIS seconded the motion, which was carried without discussion.

The CHAIRMAN proposed a hearty vote of thanks to the staff, which he said was highly deserved.

MR. M. R. PRYOR seconded the motion, which was carried, and the proceedings terminated with a vote of thanks to the board.

Consolidated Gas, Electric Light and Power Co. of Baltimore.—A dividend for the quarter of 1 per cent. is announced.

Oxford Electric Co., Ltd.—Subject to final audit, the directors recommend a dividend on ordinary share capital at the rate of 4¼ per cent. for the half-year ended December 31st last, less income-tax, which, with the interim dividend of 3 per cent. paid in September last, makes a distribution of 7¼ per cent. for the year, less income-tax.

Cambridge Electric Supply Co., Ltd.

THE report of the directors for the year ended December last, states that there have been connected 152 additional consumers, having the equivalent of 5,008 (30-watt) lamps, making a total to date of 70,987. The units supplied during the year were 632,267, an increase of 10,819 units. The larger sale of units is partly due to the increased use of electrical energy for power and heating, and it is expected that for the same reason the output will increase still further in the current year. The cheapness of electric lighting with the metal-filament lamps has been the means of inducing consumers whose premises were only partly lit to extend the lighting, as well as of attracting new consumers. A number of additional premises are now being wired and the supply mains have had to be extended in several directions. The accounts of the company show a total profit for the year of £7,838, which, added to £826 brought forward from 1909, makes £8,664. After deducting debenture and other interest £1,835, placing £1,500 to depreciation fund account, which will bring up the total placed to the credit of that account to £15,500, and writing £638 off suspense account which will extinguish that account, there remains a balance of £4,691. An interim dividend of 2 per cent., absorbing £1,696, has already been paid, and the directors recommend the payment of a further dividend of 2½ per cent., making 4½ per cent. for the year. This will absorb £2,120, leaving a balance to carry forward of about £874.

Bruce Peebles & Co., Ltd.

THE annual report of the directors to December, 1910, to which we made a brief reference last week, is to be submitted at the second annual meeting at East Pilton, Edinburgh, to-day (Friday). The report states that further unsecured debentures amounting to £9,797, and shares amounting to £16,328, have been issued in accordance with the scheme of reconstruction. The trading after deducting maintenance, general charges, expenses of administration and the interest on the mortgage debentures and unsecured debentures, shows an adverse balance of £7,275 for the year. Attention has been given to extensions of the organisation, especially with regard to obtaining business abroad, and substantial improvement is evidenced in the present accounts. Competition during the year has continued to be acute, and prices have ruled low, but an increased volume of work has been obtained and marked progress has been made. All contracts left unfinished by the old company have now been completed satisfactorily. All buildings, machinery and plant have been properly maintained during the year, and no additions have been charged to capital in respect of the improvements made.

London Electric Railway Co.

LORD GEORGE HAMILTON (chairman), presided on Thursday, February 9th, at the Westminster Palace Hotel, over the half-yearly meeting of the above company.

In proposing the adoption of the report (see ELECTRICAL REVIEW, page 229), the CHAIRMAN said that the debenture stock now stood at £2,215,000, whilst in the details of capital expenditure for the half-year there was an increase of £9,396,000. Of this £8,962,000 was capital given in exchange for the undertakings of the other two companies; £400,000 was in liquidation of accounts outstanding under contracts, and there were also certain legal expenses. These were figures incidental to the amalgamation and they would disappear in future accounts. What they now had to deal with was a consolidated company, with a capital of £12,600,000 and debenture stock amounting to £4,200,000. As regarded capital expenditure, the estimate for the future was that they would require in the next few years about £200,000, of which £20,000 would be spent in the course of the next six months. The half-year's working had not been unsatisfactory. They carried 46,662,000 passengers, although they would notice that this was a decrease compared with the figures of the three companies for the period ending June, 1910. The explanation of this was that previously a passenger taking a through ticket and passing over three railways was counted as three passengers, whereas now he was only counted as one. The passenger earnings for the last half-year were £332,000 odd, showing an increase of £3,997 over the six months of the corresponding period in the preceding year; and the average receipt per passenger was 1·71d. In the past six months they had made certain revisions of fares necessitated by the amalgamation, and had increased the hours during which workmen's trains ran, and this had resulted in a considerable increase in the persons using the trains. The total revenue for the half-year amounted to £352,000, showing an increase of £6,837. The working expenses amounted to £166,546, or a diminution of £4,529. This diminution was mainly due to the lower price they paid for current. The increase in the working expenses would have been greater but for certain improvements in the conditions of the employés. They proposed to replace the arc lamps which illuminated their stations by incandescent, as they found by experiment that the latter were much more effective and cheaper, and they hoped the cost of the replacement would shortly be recouped by the lesser expenditure entailed. After paying their debenture interest they had a balance of £101,876. The preference 4 per cent. absorbed £63,100 of that sum, leaving £38,874, and out of this they proposed to declare a dividend of ¾ per cent. on the ordinary stock and carry forward £3,474. An examination of their passenger traffic showed that they were subject to very serious competition over their shorter distances, but their traffic for longer distances was very satisfactory, and it was clearly the policy of the company to link up at the great distributing centres, and to facilitate as far as they possibly could exchange between their own and connecting lines. They had accordingly promoted a Bill which had two objects in view. In the first place it was proposed to extend the railway from the Edgware Road to Paddington, and they had made satisfactory arrangements with the Great Western Railway Co., who would, during the earlier stages, pay an annual contribution towards the cost. They were also promoting a Bill similar to that of last year for establishing a satisfactory physical connection between the various tubes and the District Railway at Charing Cross. The proposal was to extend the Hampstead line with a loop, and to so contrive for the platforms of the three lines to be in direct physical connection, and for that purpose they proposed to make use of a new method of staircase or escalator, which had been found very convenient wherever tried. The Bill also took power to sell electrical current to companies with whom they were in physical connection. At present the power house at Lot's Road was capable of producing more current than was now consumed, and it was only reasonable that they should try and get the best return for that power house. They also asked for authority to incur expenditure in connection with omnibus and other road vehicles, as in one or two instances they had found them convenient in increasing the traffic at isolated stations, but they did not propose to incur any heavy expenditure in this connection. The chairman then proceeded to explain the Bill which the District Railway is promoting seeking powers to incorporate a Joint Committee of the railway and the London Electric Railway Co. to purchase the generating station of the Underground Electric Railways Co. of London, from which both railways are now bound to take their electric current. [The details were given in Lord Geo. Hamilton's speech at the Metropolitan District Railway meeting, our report of which is held over owing to heavy pressure upon our space.] As regarded the half-year's profits of the company, they had to remember that they had worked under unfavourable conditions, owing to the death of the King causing depression in the metropolis, from which they only appeared to be just recovering. Secondly, they had had to meet a new competition in the new tramways of the L.C.C. running almost parallel with the Hampstead line. These undoubtedly attracted a certain amount of their traffic, but he was glad to say they seemed to be gradually recovering it. He thought, therefore, they could confidently anticipate an increase of their traffic in the coming year, especially if the Coronation was successful.

SIR ALGERNON WEST seconded the adoption of the report, and it was carried without discussion.

A special meeting was then held, and resolutions approving of the two Bills referred to by the chairman were carried.

Replying to a vote of thanks, the CHAIRMAN observed that, whilst their improvement could not be very rapid, their object was to make it continuous and steady.

Companies Struck off the Register.—The following companies have been struck off the register, and are accordingly dissolved:—

Anglo-Spanish Electricity Co., Ltd.
Cassel Self-Regulating Water Wheels, Ltd.
Chemical and Electrolytic Syndicate, Ltd.
Cycle Electric Lamp Co., Ltd.
Electric Castings and Engineering Co., Ltd.
Elmore's Trust, Ltd.
Greville Electrical Inventions, Ltd.
Harwich Electric Lighting and Tramways Co., Ltd.
Loughborough and District Electric Traction Syndicate, Ltd.
Marvin-Sandycroft Electric Drill Syndicate, Ltd.
Mexican Gas and Electric Light Co., Ltd.
North Wales and District Light Railway and Electric Power Syndicate, Ltd.
Pearson Fire Alarm Syndicate (Railways, Docks and Shipping), Ltd.
Peru Telephone Co., Ltd.
South American Electric Co., Ltd.
Thomson-Davis Telephone System, Ltd.
Traction Co. of the United Kingdom, Ltd.
Tramway Traction Co., Ltd.
Universal Lighting Syndicate, Ltd.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Central Electric Supply Co., Ltd.—£50,000 additional 4 per cent. guaranteed debenture stock.
United Electric Tramways of Monte Video, Ltd.—Further issue of 10,723 6 per cent. cumulative preference shares of £5 each fully paid.

Mather & Platt, Ltd.—The directors' report states that the net profits for the year to December 31st, after charging depreciation and directors' remuneration and expenses, are £109,720, plus £19,879 brought forward, showing an available total of £129,600. The preference dividend and the interim dividend on the ordinary shares paid on September 1st for the half-year to June 30th absorbed £40,000, leaving for disposal £89,600. The directors recommend a dividend for the half-year to December 31st of 5 per cent. per annum on the preference shares, £10,000; dividend for the year at the rate of 10 per cent. per annum (free of income-tax) on the ordinary shares (less interim dividend paid in September), £30,000; bonus of 2 per cent. (free of income-tax) on the ordinary shares, £12,000; leaving to be carried forward £37,600.

Held Over.—Pressure upon our space compels us to hold over until next week several reports and meetings of companies.

Gandy Belt Manufacturing Co., Ltd.—The directors report a net trading profit of £15,136 for 1910. After writing off depreciation and putting £1,000 to reserve, the dividend paid for the year is 9 per cent. with £1,820 to carry forward.

MARKET QUOTATIONS.

Wednesday, February 15th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	„	28/-	..
a „ Sulphuric	„	5/6	..
a Ammoniac, Sal	„	42/-	..
a Ammonia, Muriate (crystal)	per ton	£29	..
a „ „	„	£30	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon (50 %)	„	£9 10	..
a Copper Sulphate	„	£21	..
a Lead, Nitrate	„	£25	..
a „ White Sugar	„	£22 15	..
a „ Peroxide	„	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a „ Chlorate	per lb.	3½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide	„	7d.	..
a Shellac	per cwt.	80/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70 %)	„	£11	..
a „ Chlorate	per lb.	3½d.	..
a „ Crystals	per ton	£8 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
a „ Cyanide (basis 100 %)	„	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£75	..
b „ Wire, in ton lots	„	£102	..
b „ Sheet, in ton lots	„	£120	..
p Babbitt's metal ingots	„	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	6¼d.	..
c „ Tube (brazed)	„	8¾d.	..
c „ „ (solid drawn)	„	6¾d.	..
c „ Wire, basis	„	6¼d.	..
c Copper Tubes (brazed)	„	8¾d.	..
c „ „ (solid drawn	„	8¼d.	..
g „ Bars (best selected)	per ton	£70	£1 inc.
g „ Sheet	„	£70	£1 inc.
g „ Rod	„	£70	£1 inc.
e „ (Electrolytic) Bars	„	£57 15	5/- inc.
e „ „ Sheets	„	£78 15	£5 5 inc.
e „ „ Rod	„	£62	£1 inc.
c „ „ H.C. Wire	per lb.	7$\frac{5}{16}$d.	$\frac{1}{16}$d. dec.
f Ebonite Rod	„	6/-	..
f „ Sheet	„	5/6	..
n German Silver Wire	„	1/11	..
h Gutta-percha, fine	„	8/6	..
h India-rubber, Para fine	„	6/3	8d. inc.
l Iron Pig (Cleveland warrants)	per ton	49/0½	1d. dec.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Ingot	„	£13 2 6 to £13 7 6	5/- dec.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£8 10	10/- inc.
d Mica (in original cases) small	per lb.	6d. to 1s.	..
d „ „ „ medium	„	2/6 to 4/-	..
d „ „ „ large	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	11d.	..
p „ „ rolled bars & rods	„	1/0½	..
p „ „ rolled strip & sheet	„	1/1	..
o Platinum	per oz.	160/-	..
e Silicium Bronze Wire	per lb.	8¾d.	..
r Steel Magnet, in bars	per ton	£55	nominal.
g Tin, Block (English)	„	..	..
n „ Wire, Nos. 1 to 16	per lb.	2/2	2d. inc.
p White Anti-friction Metals	per ton	£45 to £150	..
k Zinc, Sh's (Vieille Montagne bnd.)	„	£28 15	£1 dec.

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

City of Buenos Ayres Tramways (1904), Ltd.—The directors' report to December, 1910, states that the annuity payable by the Anglo-Argentine Tramways Co., Ltd., has been received. The net revenue for the year was £65,865. Interim dividends have been paid for the nine months ended December 30th, 1910, absorbing £46,500, leaving a balance of £19,365. The directors recommend that, in addition to the interim dividends already distributed, a final dividend of 1s. 3d. per share (making 5s. per share, less income-tax), be paid, absorbing £15,500, £3,800 is transferred to the general amortisation fund, and £65 carried forward.

Hankow Light and Power Co.—A meeting of this company was held on Monday at the offices, 21, Ironmonger Lane, E.C. A representative of the ELECTRICAL REVIEW who attended to report the proceedings was informed that the meeting was private, and a request for a copy of the report was met with the reply that it was not the annual, but a special meeting.

STOCKS AND SHARES.

Tuesday Evening.

QUITE the feature of the present week is the unwonted activity in Home Railway stocks of the steam companies. Animation and good prices have been so long unknown in this department that their coming tempted a good deal of selling by a "short" division, and the bear account so created has been a valuable auxiliary to the purchases made for investment and speculation. Of the steam lines interested in electricity, the Brighton has been strongly favoured, and another is the East London, on revived hopes that the Midland-Tilbury agreement may lead to early developments in favour of the East London Company. The Ordinary stock rose to 5, and the "C" and "D" Debentures—both of which have been indicated here on various occasions as good things for the long lock-up—have made substantial advances.

It must be admitted that beyond a gain of two points in Metropolitan Consolidated, the electrical railway section has been overlooked rather badly. Central London Ordinary regained the deducted dividend of 30s., and the Deferred at 48 *ex* 2 per cent. dividend, is really a point to the good on balance. The shareholders' meeting, reported on page 231 of last week's issue, was marked by an air of optimism of the highly subdued order, and the chairman did not seem to go out of his way in order to put—not necessarily an enthusiastic—but even a bright aspect upon the outlook. City and South London's dividend of 17s. 6d. per cent., corresponds pretty well with the deduction of a point from the price. Districts are amongst the few stocks that display weakness, and there appears to be some sort of nervousness, but the alliance between the Central London and the Great Western may have prejudicial effects upon the District's traffics at the Ealing end of the town.

Electricity Supply shares have stopped a little in their mad upward career, but the previous advances are all held, and in a few instances further improvements have occurred; Westminster Ordinary, for example, are ½ higher, and Brompton Preference secured a gain of a similar fraction. County of Londons have risen in both classes, and Chelseas put on 2s. 6d. Charing Cross Preference are *ex* 2s. 3d. dividend, without changing their previous quotation. The investment demand has slackened off just a trifle, and in consequence there is not so much marking-up in course of progress.

Brush Preference have come quietly into demand, and from being nothing to 2s. 6d., the official quotation has hardened to $\frac{1}{32}$-$\frac{5}{32}$. The company's Debenture stocks have not further improved upon their rises of last week. Edison & Swan "A" shares of £5 each, with £3 paid, which only a little while ago had to be sold with cartage money to escape the liability, are now up to 7s. 6d., although in their case as well the Debenture stocks have not changed.

The feature, perhaps, in the price lists overleaf, is the jump in British Electric Tractions this week. The Ordinary rose 10s., the Preference 18s. 9d., and the prior charge securities 2 points apiece. We met a jobber in the tram on Monday night who declared himself tired out with the result of his day's work in dealing in Tractions. Asked for the reason of the remarkable improvement, he laughingly confessed entire ignorance, and said that his only concern was to make good profits out of the dealing: "The reason," he added, "is no concern of mine," and this attitude of mind is not a bit uncommon amongst the very people who, above all others, might be supposed to be the fount of knowledge in regard to some particular stock or share. Rumour reiterates the impression mentioned here a fortnight back to the effect that an increased dividend will be declared upon the Preference shares. Moreover, the highly dramatic rise in London General Omnibus stock has attracted more public attention to kindred companies' issues, and Metropolitan Electric Trams Deferred are 1s. 3d. better, business being done at 5s. and over, before the price ebbed away to 4s. 4½d. The London United Tramways report shows that the new manager is already making his influence felt for good, and the Preference shares rose 12s. 6d.

Mexico Trams are now fully recovered from the effect of the so-called revolution, and the price is up 2½, taking the Bonds more quietly in their train. Rio Trams have recovered to 112, and the Bonds are a good market at 100½ and 97½ for the 30-year and 50-year issues respectively. The proposed Reciprocity Agreement between Canada and the United States has helped to impart a better tone to most Canadian investments, the general feeling being that trade of all kinds in the Dominion will be stimulated if, and when, the Agreement passes into law.

A lively gamble has sprung up in National Telephone Deferred stock, and the price shot up 5 on heavy purchases, reacting a couple of points later on. The Preferred stock and the three kinds of Preference shares are all better. Anglo-American Telegraph have sunk into a secondary place as popular favourites, and the falls in price just about reflect the dividends which came off last Friday. Direct United States shares are harder, Indo-Europeans rose 1, and Eastern Extensions gained 5s. There are rumours that the Amazon Company is about to be amalgamated with some other. Oriental and Chili Telephones are slightly better. West India and Panama have reacted again.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1907.	1908.	1909.	1910.	Closing Quotations Feb. 7th.	Closing Quotations Feb. 14th.	Business done week ended Feb. 14th, 1911. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
300,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	Nil.
$263,244,000	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	96 — 98	96 — 98	97⅛	96⅞	..	5 2 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	..	149 —151	149 —151	150⅛	149½	..	5 6 0
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	93 — 95	93 — 95	.	..	..	4 4 3
545,920	Anglo-American Telegraph	Stock	3¼%	£3 4s.	3⅜%	3⅜%	69½— 71½	67½— 69½ xd	69⅛	68½	..	5 7 11
3,227,040	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	112⅜—113¾	111¼—112½ xd	113⅛	111⅝	..	5 6 11
3,227,040	Do. do. do. Deferred	Stock	1 %	8/-	25/-	30/-	27⅝— 28⅜	26⅜— 26⅝ xd	27⅜	26 3/16	..	5 13 2
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	..	6 13/16 — 7 3/16	7 — 7¼	7 3/16	7 1/16	+ 1/16	5 10 4
2,462,309	Commercial Cable, Sting. 500 year 4% Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	87½	86	..	4 10 11
16,000	Cuba Telegraph	10	6 %	6 %	6 %	..	9 — 9¼	9 — 9¼	..	..	..	6 3 1
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	..	17 — 18	17 — 18	..	..	..	5 11 1
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3¾— 4	3¾— 4	..	..	..	5 0 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10%	8¼— 8¾	8¼— 8¾	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99½—101¼	99½—101¼	..	..	..	4 8 8
60,710	Direct United States Cable	20	4½%	4½%	4 %	5 %	15⅛— 16	15⅝— 16⅜	15 1/16	15⅜	+ ⅛	6 4 3
32,500	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,300, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	135 —138	135 —138	137	135⅞	..	5 1 5
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	84 — 86	84 — 86	84⅛	..	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	100¼—102½	100¼—102⅝	102¼	102⅛	..	3 18 1
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13 — 13⅛	13⅛ — 13¼	13 3/16	13 1/16	..	5 1 10
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —101	99 —101	99½	..	..	3 19 3
200,000	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	100 —102	100¼—102½	..	..	+ ½	3 18 1
181,127	Globe Telegraph and Trust	10	5⅞%	5⅞%	5⅞%	..	10¼— 10⅜	10¼— 10⅜	10⅜	10⅜	..	5 9 5
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	13¼— 13⅜	13¼— 13⅜	13 1/16	13⅛	..	4 8 1
150,000	Great Northern Telegraph, of Copenhagen..	10	20 %	18 %	18 %	..	32 — 33	32 — 33	..	..	..	5 9 1
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	..	55 — 57	56 — 58	56½	56⅜	+1	5 16 5
$41,380,400	Mackay Companies Common	$100	4 %	4 %	4½%	5 %	94 — 97	94 — 97	..	..	..	4 7 8
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	77 — 79	77 — 79	..	..	..	5 1 3
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	1 5/16 — 1 7/16	1 5/16 — 1 7/16	17/6	16/6	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	..	1 — 1	1 — 1	18/-	17/6	..	6 0 0
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	31/32 — 1	31/32 — 1	..	..	..	5 11 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106½—107½	107 —108	107½	107	+ ½	5 11 1
3,725,000	Do. do. Def. Stock	100	6 %	6 %	6 %	6 %	134 —136	137 —139	140½	135½	+3	4 6 4
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10¾	10¼— 10⅝	..	..	+ ⅛	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10¾— 11	10⅝— 11⅛	11	10⅝	+ ⅛	5 7 10
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5¾— 6	6 — 6⅛	6⅛	6	+ ⅛	4 1 8
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	98⅝	..	..	3 10 0
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..	4 0 0
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	8 %	8 %	8 %	..	1 3/32 — 1 5/32	1 1/32 — 1 1/16	35/-	..	+ 1/32	4 10 2
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	87 — 89	87 — 89	..	..	..	4 9 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	97½— 99½	97½— 99½	..	..	..	4 0 5
11,889	Reuter's	8	5 %	5 %	5 %	..	7½— 8	7½— 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	96¼— 98½	96½— 98½	..	..	..	4 11 5
2,992	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	133 —136	133 —136	..	..	..	4 8 3
150,000	United River Plate Telephone	5	8 %	8 %	8 %	..	7¼— 7⅜	7¼— 7⅜	7 1/16	7 3/32	..	5 6 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5⅜	..	..	4 6 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1¼— 1½	1¼— 1⅜	..	..	..	4 3 4
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97½— 99½	97⅞— 99½	..	..	..	4 0 5
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13⅜— 14⅛	13⅜— 14⅛	13⅜	..	..	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99½—101½	99½—101⅜	100	..	..	3 18 10
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	2¼— 2⅜	2⅜— 2⅝	50/7½	45/7½	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10 — 10½	10 — 10½	10¼	..	..	5 14 3
4,669	Do. do. 6 % Cum. 2nd Pref.	10	£2 6	15 %	14⅓%	..	8¾— 9¼	8¾— 9¼	..	..	..	6 9 9
80,000	Do. do. 5 % Debs., Nos. 1 to 800 ..	100	5 %	5 %	5 %	5 %	101 —103	101 —103	..	..	..	4 17 1

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	5 %	..	4 17/32 — 5 1/32	4¼ — 5⅛	5 1/32	98/9	+ 1/32	4 17 7
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	5 %	..	4 7/16 — 4 17/32	4 9/16 — 4 17/32	93/9	93/11½	+ 1/32	5 8 11
4,465,674	Do. 4 % Deb. Stock	Stock	..	4 %	4 %	4 %	91½— 93	92 — 93⅜	92⅝	92½	+ ⅛	4 5 7
329,002	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	101¼—103½	102½—104½	..	..	+1	4 15 8
830,000	Babcock & Wilcox, 1 to 830,000	1	20 %	20 %	24 %	..	5 3/16 — 5⅜	5 3/16 — 5⅜	5 3/16	5 1/16	..	4 2 1
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1 3/16 — 1 ¼	1 3/16 — 1 ¼	..	..	..	4 0 0
600,000	British Columbia E. Rail Def. Ord. Stock	100	8 %	8 %	8 %	..	145 —148	145 —148	147	145½	..	4 13 0
600,000	Do. Pref. Ord. Stock	100	5 %	6 %	6 %	..	126 —130	125 —129	127½	126½	—1	4 8 6
600,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	..	110 —113	110 —113	111	110	..	4 9 3
230,800	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102¼—104½	102¼—104½	..	..	..	4 6 2
210,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	102 —105	102 —105	103	..	..	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	..	1 7/16 — 1 11/16	1 15/16 — 2 3/16	47/6	31/-	+ ⅛	Nil
161,497	Do. do. 6 % Cum. Pref.	10	8 %	14%	Nil	..	5 3/16 — 5⅜	4 15/16 — 5 1/16	5⅛	81/3	+ ⅛	Nil
1,478,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	91 — 96	93 — 98	96	94	+2	5 2 0
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	73 — 78	75 — 80	77	74½	+2	5 12 6
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	..	7 — 7⅛	7 — 7⅛	..	..	..	6 13 4
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5⅞— 6⅛	5⅞— 6⅛	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
201,579	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
500,000	British Westinghouse 10 % Pref., 1 to 200,000 and 275,001 to 575,000 Non-cum.	5	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	10/8	8/9	+ ⅛	Nil
1,241,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	54 — 57	55 — 58	..	..	+ 1	6 17 11
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	..	11/16 — 13/16	13/16 — 15/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,888	Brush Electrical Engineering, Ord., 1 to 140,888 ..	2	Nil	Nil	Nil	..	0 — ⅛	0 — ⅛	..	..	..	Nil
199,885	Do. do. Non-cum. 7 % Pref... ..	2	Nil	Nil	Nil	..	0 — 1/32	1/32 — 3/32	..	..	+ 1/32	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	40 — 45	40 — 45	..	..	..	10 0 0
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	28 — 32	28 — 32	..	..	+4½	14 1 4
197,610	Calcutta Trams, 1 to 197,610	5	6 %	4½%	4½%	..	5 — 5⅛	5⅛ — 5⅜	5⅜	..	+ ⅛	4 0 0
47,295	Do. 5 % Cum. Pref., 1 to 47,295 ..	5	5 %	5 %	5 %	..	4¼— 5⅛	4¼— 5⅛	..	..	..	5 0 0
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	97 —100	..	..	+1	4 10 0
35,000	Callender's Cable Construction shares	5	15 %	15 %	10 %	..	9⅛— 9⅜	9⅛— 9⅜	9 7/8	9⅛	..	5 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4½— 5	4½— 5	97/6	..	..	4 18 0
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	⅜ — ½	7/16 — 9/16	13/-	12/6	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	12 %	12½%	17½%	..	3 3/16 — 3 5/16	3 3/16 — 3 5/16	65/8	63/6	..	5 6 1
205,369	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4½%	4½%	103 —106	103 —106	..	..	..	4 4 11
1,864,720	Central London Railway, Ord. Stock	Stock	3 %	3½%	3 %	3 %	66 — 68	66 — 68 xd	68⅜	66⅜	..	4 8 3
572,640	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	83 — 85 xd	84⅜	..	..	4 14 8
572,640	Do. do. Def. do.	Stock	2 %	2½%	2 %	2 %	48 — 50	47 — 49 xd	49⅛	47	..	4 1 8
1,480,000	City and South London Railway	Stock	2½%	1½%	1½%	1½%	27⅛— 28⅛	28 — 29 xd	28⅛	26½	..	5 3 5
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..	Nil
100,000	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 1,100 of £50 Red	..	5 %	5 %	5 %	5 %	70 — 80	70 — 80	..	..	..	6 0 5

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1907.	1908.	1909.	1910.	Closing Quotations Feb. 7th.	Closing Quotations Feb. 14th.	Business done week ended Feb. 14th, 1911. Highest	Lowest	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	6 %	5 %	..	37— 31/32	1 5/16— 1 3/16	21/8	20/9	+ 3/32	4 14 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1 1/8	1 — 1 1/8	..	..	..	5 6 8
365,430	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½— 13½	12½— 13½ xd	..	..	..	4 10 7
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	2½%	Nil	Nil	..	3/32— 7/32	3/32— 7/32	8/-	3/6	+ 3/32	Nil
17,189	Do. "A" shares, 01—017,189	5	2½%	Nil	Nil	..	1 — 1⅛	1 5/32— 1 3/32	..	..	+ 3/32	Nil
807,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	61 — 66	61 — 66	..	..	..	6 1 3
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	..	3/32 1	3/32 1	19/6	16/-	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1 1/32— 2 3/32	1 1/32— 2 3/32	89/4½	38/9	..	6 10 3
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84	..	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	½%	Nil	Nil	..	3/32 1	3/32 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	..	10½ 10⅜	10½ 10⅜	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103⅞	102 —103⅞	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	..	12½— 13	12½— 13	12¾	..	..	5 15 5
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5 — 5¼	5 — 5¼	..	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..	4 5 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	..	15⅞— 16⅛	15⅞— 16⅛	16½	..	+ ⅛	6 1 3
37,500	†Liverpool Overhead Railway, Ord.	10	½%	Nil	Nil	1½%	1⅜— 1⅝	1 1/16— 1 3/16	..	..	+ 1/16	8 6 5
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	6¾— 7¼	7 — 7⅝	..	..	+ ¼	6 18 4
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	Nil	Nil	Nil	1¼— 2⅛	1½— 2⅛	..	..	..	Nil
999,930	Do. do. 60,008 to 100,000	10	3 %	Nil	Nil	Nil	1¼— 2⅛	1½— 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	3½%	Nil	Nil	1¾— 2¼	2⅛— 2⅝	42/-	..	+ ⅛	..
1,649,930	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	69 — 73	70 — 74	..	..	+1	5 8 1
5,782,062	Metropolitan Consolidated	100	⅛%	⅛%	1 %	1⅛%	39½ — 40	41⅛ — 42	42	39⅜	+2	2 13 7
2,640,914	Do. Surplus Lands	100	2⅜%	2⅜%	2⅜%	2⅜%	63 — 65	63 — 65	63½	..	..	4 3 4
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	26⅛ — 27	25⅞— 26⅛	26⅛	25⅞	— ⅛	Nil
891,337	Metropolitan Electric Trams., Ord.	1	..	4½%	5%	..	1⅛— 1⅛	1⅛— 1⅛	20/8	19/9	..	4 14 1
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	3/32— 3/32	3/32— 3/32	5/-	4/-	+ 1/16	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	1 — 1	1 xd	18/6	18/-	..	5 0 0
589,183	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	..	99½—101¼	99¼—101½	102½	100⅜	..	4 8 8
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	6 %	..	126⅜—127⅞	129 —130	130	127⅜	+2½	4 12 4
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	5 %	5 %	..	99½—100⅜	99⅜—100⅜	100⅜	100	+ ⅛	4 19 3
245,000	Potteries Electric Traction	1	4 %	Nil	2 %	..	1/16— 1/16	1/16— 1/16	5/-	..	..	6 8 0
245,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	3/32— 3/32	3/32— 3/32 xd	11/8	11/-	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
37,350	Telegraph Construction and Maintenance	12	17½%	15 %	17½%	20 %	39 — 41	39 — 41	..	..	..	5 17 8
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1919	100	4 %	4 %	4 %	4 %	100 —102	100 —102	100⅛	..	..	4 0 0
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	5 %	5 %	..	102½—103⅛	102½—103⅛	103⅛	102⅜	..	4 16 7
2,818,700	Do. do. 4½ % Bonds	..	..	4½%	4½%	..	95 — 97	95 — 97	96⅛	95⅜	..	4 12 9
4,928,050	Do. do. 6 % Income Bonds	..	..	..	..	1 %	43 — 45	43 — 45	44½	43½	..	2 4 5
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	10 %	5 %	Nil	..	3/32— 3/32	3/32— 3/32	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	6 %	3 %	..	1 — 1½	1 — 1½	..	..	..	10 0 0
215,769	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	60	..	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 30,449	5	10 %	10 %	10 %	..	7¼— 7⅝	7¼— 7⅝	7 1/16	7¼	..	6 9 0
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7 — 7⅛	7¼— 7⅝	..	..	+ ⅛	4 10 4
402,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —103	99 —103	..	..	..	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	..	3⅞— 4⅛	3⅞— 4⅛	..	..	..	5 14 3
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4⅛— 4⅜	4⅛— 4⅜ xd	87/6	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	3⅜— 4⅛	3⅜— 4⅛	..	..	..	5 7 6
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
49,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	5 %	4 — 4½	4⅛— 4⅜	88/9	87/6	+ ⅛	5 8 1
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	7 %	..	11⅞— 12⅜	11⅞— 12⅜	12 1/16	12⅛	..	5 13 2
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	12 — 13	12 — 13	..	..	..	4 12 4
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	118 —122	118 —122	120½	..	..	4 2 0
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
50,000	County of Durham Electrical Power, Ord.	5	2 %	Nil	Nil	..	1¾— 2	1¾— 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	2⅝— 3⅛	2⅝— 3⅛	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	5 %	5 %	5 %	92 — 94	92 — 94	..	..	..	5 6 5
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	..	7⅞— 8⅛	7⅞— 8⅛	..	..	+ ⅛	6 1 3
55,000	Do. do. 6 % Pref., 40,001—80,000 and 120,001—135,000	10	6 %	6 %	6 %	..	10½— 11	10⅝— 11⅛	11	10¾	+ ⅛	5 2 2
450,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	104 —107	105 —108	..	..	+1	4 8 4
450,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	3/32— 3/32	3/32— 3/32	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	Nil	Nil	Nil	..	1⅝— 2	1⅝— 2	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 79	78 — 81	..	..	+2	5 11 1
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	5 %	5 %	..	82 — 84	83 — 85	84¼	84	+1	5 17 8
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	4⅛— 4⅝	4⅛— 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	..	4⅛— 5⅛	4⅛— 5⅛	..	..	..	4 11 11
94,350	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
15,000	Hove, 1 to 15,000	5	8½%	8½%	8½%	..	6⅝— 7⅛	6⅝— 7⅛	..	..	..	5 19 4
$1,526,500	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	5 %	5 %	..	101 —103	101 —103	103⅜	..	..	4 17 1
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	8 %	8 %	..	6½— 6⅝	6½— 6⅝	..	..	..	5 18 6
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
111,000	London Electric Supply Corporation, Limited, Ord.	3	2½%	3 %	2 %	..	1⅝— 2	1⅝— 2	..	..	..	3 0 4
90,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅞— 5½	4⅞— 5½	5	..	..	5 14 3
887,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½%	4 %	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
200,000	Metropolitan Electric Supply, 100,001 to 300,000	5	6½%	5 %	5 %	..	4⅜— 4⅞	4⅜— 4⅝	91/10½	..	..	5 2 7
76,121	Do. 4½ % Cum. Pref. 1—76,121	5	4½%	4½%	4½%	..	4¼— 4⅓	4⅓— 4⅝	88/9	..	..	5 0 0
250,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
248,000	Do. 5½ % Mort. Deben. Stock Redem.	Stock	5½%	5½%	5½%	5½%	83 — 86	83 — 86	..	..	..	4 1 5
$5,929,600	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	89 — 90	89½ — 90⅛	89½	89½	+ ½	5 10 6
$13,585,000	Do. Light and Power Co., Ltd., Common	$100	4 %	3½%	4 %	..	93¼— 94½	93½— 94⅜	94½	93¾	..	4 4 8
$5,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	7 %	7 %	..	110½—111½	112⅛—113¼	113⅝	110⅝	+1½	6 3 4
$12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	5 %	5 %	5 %	94 — 95 xd	95 — 96	96	94½	+1	5 4 2
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..	4 11 10
130,491	Newcastle-on-Tyne, 1 to 50,000 & 57,010 to 137,500	5	8 %	2½%	4 %	..	3⅜— 4¼	3⅜— 4¼	..	..	..	2 12 9
137,500	Do. 5% Pref., 1 to 137,500 Non. Cum.	5	5 %	5 %	5 %	..	4⅜— 4⅝	4⅜— 4⅝	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	5 %	..	97½— 99½	97½ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7 %	7½%	..	11⅛— 12⅛	11⅛— 12⅛	..	..	..	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 ..	7 %	..	6⅞— 6⅞	6⅞— 6⅞	..	..	..	5 3 8
120,000	River Plate Elcty. Co. Ord.	Stock	6 %	8 %	9 %	..	228 —238	228—238	234	231	..	3 15 8
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	..	103 —113	103—113	..	..	..	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	103½	..	..	4 16 3
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10%	8⅞— 9	8⅞— 9	..	..	..	5 11 1
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6¾— 7⅜	6¾— 7⅜	..	..	..	4 0 6
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	Nil	1⅝— 2	1⅝— 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	4 %	5 %	5 %	5 %	3 — 3⅜	3 — 3⅜	..	..	..	5 19 5
100,000	Do. do. 5 % 1st Mort. Deb.	100	..	5 %	5 %	5 %	101 —104	101 —104	..	..	..	4 16 3
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	Nil	..	3/32— 3/32	3/32— 3/32	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	..	1 5/16— 1 7/16	1 5/16— 1 7/16	20/6	20/3	..	6 16 7
240,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	3/32— 3/32	3/32— 3/32	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	1⅜— 2⅛	1⅜— 2⅛	39/4½	..	..	11 2 0
271,700	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	79 — 83	80 — 84	80½	..	+1	5 7 2
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	5 %	..	..	15/16— 7/8	15/16— 7/8	17/6	..	..	5 14 3
110,000	Westminster Electric Supply, Ord.	5	10 %	10 %	10 %	10%	8 — 8½	8¼— 8½	8½	8⅜	+ ¼	5 15 11
81,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 3 9

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent. January 26th, 1911.

TRADE STATISTICS OF ITALY.

The following figures, showing the imports of electrical and similar goods into Italy during the year 1909, have been taken from the recently issued official trade statistics; the figures for 1908 have been added for purposes of comparison, and notes of increases or decreases are given :—

	1908. Lire.	1909. Lire.	Increase or decrease. Lire.
Iron and steel wire of a diameter from 5 mm. to 1½ mm.—			
From France	16,000	18,000	+ 2,000
„ Germany	206,000	153,000	— 53,000
„ Great Britain ...	45,000	37,000	— 8,000
„ Other countries ...	10,000	8,000	— 2,000
Total ...	277,000	216,000	— 61,000
Iron and steel wire having a diameter of 1½ mm. or less.—			
From Germany	252,000	210,000	— 42,000
„ Great Britain ...	27,000	69,000	+ 42,000
„ Other countries ...	46,000	22,000	— 24,000
Total ...	325,000	301,000	— 24,000
Copper, brass or bronze wire more than ½ mm. diameter.—			
From France	896,000	2,774,000	+1,878,000
„ Germany	2,596,000	1,267,000	—1,329,000
„ Great Britain ...	44,000	20,000	— 24,000
„ Other countries ...	94,000	101,000	+ 7,000
Total ...	3,630,000	4,162,000	+ 532,000
Copper, brass or bronze wire of ½ mm. diameter or less.—			
From Germany	374,000	430,000	+ 56,000
„ France	31,000	19,000	— 12,000
„ Other countries ...	4,000	13,000	+ 9,000
Total ...	409,000	462,000	+ 53,000
Boilers.—			
From France	255,000	143,000	— 112,000
„ Germany	1,802,000	552,000	—1,250,000
„ Great Britain ...	4,112,000	2,469,000	—1,643,000
„ Switzerland ...	316,000	275,000	— 41,000
„ Other countries ...	962,000	428,000	— 534,000
Total ...	7,447,000	3,867,000	—3,580,000
Steam engines, fixed without boilers.—			
From Belgium	88,000	160,000	+ 72,000
„ Germany	938,000	540,000	— 398,000
„ Great Britain ...	1,417,000	739,000	— 678,000
„ Switzerland ...	632,000	279,000	— 353,000
„ United States ...	453,000	132,000	— 321,000
„ Other countries ...	104,000	230,000	+ 126,000
Total ...	3,632,000	2,080,000	—1,552,000
Steam engines, semi-fixed (with boilers), hot-air motors, compressed air, gas, petrol, &c.—			
From France	139,000	196,000	+ 57,000
„ Germany	2,140,000	1,888,000	— 252,000
„ Great Britain ...	1,466,000	1,554,000	+ 88,000
„ Switzerland ...	584,000	366,000	— 218,000
„ United States ...	104,000	323,000	+ 219,000
„ Other countries ...	303,000	152,000	— 151,000
Total ...	4,736,000	4,479,000	— 257,000
Hydraulic machines and water or wind motors.—			
From France	154,000	299,000	+ 145,000
„ Germany	961,000	633,000	— 328,000
„ Great Britain ...	180,000	116,000	— 64,000
„ Switzerland ...	98,000	369,000	+ 271,000
„ Other countries ...	165,000	172,000	+ 7,000
Total ...	1,558,000	1,589,000	+ 31,000
Dynamo-electric machines weighing more than 1,000 kg.—			
From Austria	300,000	110,000	— 190,000
„ France	869,000	587,000	— 282,000
„ Germany	7,615,000	5,603,000	—2,012,000
„ Great Britain ...	626,000	663,000	+ 37,000
„ Switzerland ...	1,222,000	1,670,000	+ 448,000
„ United States ...	494,000	358,000	— 136,000
„ Other countries ...	68,000	27,000	— 41,000
Total ...	11,194,000	9,018,000	—2,176,000
Ditto, weighing 1,000 kg. or less.—			
From Austria	129,000	162,000	+ 33,000
„ France	363,000	194,000	— 169,000
„ Germany	6,319,000	4,670,000	—1,649,000
„ Great Britain ...	191,000	200,000	+ 9,000
„ Switzerland ...	472,000	760,000	+ 288,000
„ United States ...	559,000	431,000	— 128,000
„ Other countries ...	28,000	64,000	+ 36,000
Total ...	8,061,000	6,481,000	—1,580,000
Machines not mentioned (other than agricultural, textile, sewing, paper, mills, printing, &c.).—			
From Austria	658,000	320,000	— 338,000
„ Belgium	668,000	248,000	— 420,000
„ France	1,188,000	972,000	— 216,000
„ Germany	17,210,000	10,688,000	—6,522,000
„ Great Britain ...	2,916,000	1,613,000	—1,303,000
„ Switzerland ...	842,000	822,000	— 20,000
„ United States ...	414,000	617,000	+ 203,000
„ Other countries ...	90,000	65,000	— 25,000
Total ...	23,986,000	15,345,000	—8,641,000
Electric transformers.—			
From Austria	1,037,000	752,000	— 285,000
„ France	133,000	207,000	+ 74,000
„ Germany	2,729,000	2,226,000	— 503,000
„ Great Britain ...	20,000	59,000	+ 39,000
„ Switzerland ...	293,000	539,000	+ 246,000
„ United States ...	141,000	800,000	+ 659,000
Total ...	4,353,000	4,583,000	+ 230,000
Accumulators and metal parts.—			
From Germany	325,000	42,000	— 283,000
„ Great Britain ...	2,000	20,000	+ 18,000
„ Other countries ...	71,000	39,000	— 32,000
Total ...	398,000	101,000	— 297,000
Parts of dynamo-electric machines and of transformers.—			
From France	111,000	202,000	+ 91,000
„ Germany	591,000	606,000	+ 15,000
„ Great Britain ...	96,000	100,000	+ 4,000
„ United States ...	359,000	344,000	— 15,000
„ Other countries ...	190,000	80,000	— 110,000
Total ...	1,347,000	1,332,000	— 15,000
Electrical apparatus.—			
From Germany	1,331,000	1,752,000	+ 421,000
„ Great Britain ...	185,000	22,000	— 163,000
„ Switzerland ...	24,000	248,000	+ 224,000
„ United States ...	310,000	292,000	— 18,000
„ Other countries ...	86,000	171,000	+ 85,000
Total ...	1,936,000	2,485,000	+ 549,000
Arc lamps.—			
From Germany	576,000	459,000	— 117,000
„ Great Britain ...	—	2,000	+ 2,000
„ United States ...	6,000	45,000	+ 39,000
„ Other countries ...	20,000	47,000	+ 27,000
Total ...	602,000	553,000	— 49,000
Electric lamps, incandescent.—			
From Austria	333,000	559,000	+ 226,000
„ France	103,000	130,000	+ 27,000
„ Germany	1,254,000	1,394,000	+ 140,000
„ Great Britain ...	—	5,000	+ 5,000
„ Switzerland ...	85,000	64,000	— 21,000
„ Other countries ...	52,000	71,000	+ 19,000
Total ...	1,827,000	2,223,000	+ 396,000
Carbons of all kinds for electro-technical purposes.—			
From Austria	164,000	223,000	+ 59,000
„ Germany	947,000	611,000	— 336,000
„ Switzerland ...	16,000	35,000	+ 19,000
„ Other countries ...	9,000	5,000	— 4,000
Total ...	1,136,000	874,000	— 262,000

N.B.—25 lire = £1.

Electrical Exports from Germany.—It is stated that the value of the exports of electrical products from Germany in 1910 amounted to £10,850,000, as compared with £9,000,000 in the preceding year. On the other hand, the imports of similar articles were valued at less than £350,000 in each of the years in question.

REVIEWS.

Electrical Distributing Networks and Transmission Lines. By Alfred Hay, D.Sc., M.I.E.E. London: Cassell and Co., Ltd. Price 10s. 6d. net.

Dr. Hay has set out with the intention, as expressed in his preface, of providing "a simple and concise account of the theoretical and practical aspects of a subject of great importance to every electrical engineer, but one which has not, perhaps, received as much attention as it deserves." Directly after the contents and the list of diagrams (of which there are 108) is placed a list of the symbols and abbreviations used in the work. This is a plan which might well be followed by other authors, for in using such a book as this as it is intended to be used, and as it is natural to use it—as a work of reference—it is not always easy to discover the meaning of the symbols employed in a formula. c may mean capacity, or it may mean current—in this case it means capacity, and current is indicated by *i*. Other symbols have ambiguous meanings, and other quantities are expressed in more ways than one. Hence the value of a list, prominently placed and easy to find, from which the reader can obtain immediately the meaning of any symbol used in the book.

The get-up of the book is satisfactory, the type being clear, and the paper good. From the literary side there are few faults, the most persistent being the pleonastic use of the word "one." Thus, on page 42, "the cable is spoken of as a *triple-concentric* one"; on page 45, "a solid in mechanical problems is regarded as similar to an insulator in electrical ones"; on page 134, "the supply is an alternating-current one"; on page 138, "the cables would be three-core ones," and further instances are to be found. Our old acquaintance, the split infinitive, makes two appearances, on page 199 in the expression "to completely cover" and in a footnote on page 221 as "to practically swamp." We do not remember reviewing a technical work which was entirely free from this intrusion of an interloper into a position which it ought not to occupy.

From the technical point of view, the book is excellent. Valuable information is given on every page. There is a running headline which indicates directly the principal point dealt with below it, and thus enables the reader to find the instruction of which he is in need without loss of time. There is also a very complete index. By the aid of the diagrams, many mains problems are simplified and explained, and by the aid of the table on pages 64 and 65, the operation of estimating the cost of an extension of cable is rendered quite easy.

In a work where there is so much that is useful, it is difficult to single out any point for special mention. Perhaps Chapters VIII, IX and XIV, headed respectively "Insulation Resistance of Network," "Potentials and Fault Resistances of Mains," and "Methods of Laying Underground Mains," will be of most general use to the mains engineer. In the last-named chapter, on page 208, mention is made of the discovery, due to Mr. W. M. Rogerson, of Halifax, that blackleading the ends of aluminium fuses prevented electrolytic corrosion and pitting due to local action between the aluminium and the copper clips holding it. We are not aware that any explanation has ever been given of this preventive action of the black lead.

In the words of a well-known mains engineer, this volume is "the mainsman's text-book." To those in need of a book to which to turn for advice in emergency or for guidance in cable-laying—and they are many—the work may be confidently recommended.

Génératrices de Courants et Moteurs Electriques. By Prof. C. Gutton, Nancy. Paris: Dunod & Pinat. 1911. Price 9 fr.

This work embodies the course of instruction given by the author at the University of Nancy, and is intermediate between a course on electricity and one on the design and construction of electrical machines. It deals, in fact, with the working conditions, considered from an electrical point of view, of the machines in general use. The treatment is of a character adapted to the needs of students, say, of second-year attainments. The field covered includes direct and alternating-current generators and motors of all kinds, transformers, and rotary converters, together with methods of testing; the subject is very fully dealt with, and the work appears to give an exhaustive review of the theory of all these apparatus, the bulk of the book, therefore, being devoted to A.C. machinery. The mathematical treatment is not difficult, and the book should prove an excellent means to enable a student to keep his knowledge of French up to the mark, while gaining clear ideas of the subject discussed.

How to Use the Electric Light. By Frederick H. Taylor. London: Percival Marshall & Co. Price 6d. net.

The object of this handbook is not so much to tell the householder how to use electric light, as how to use it with increased economy and efficiency, which is a very different thing. At the present day, everyone in the industry knows that anything which tends to reduce the cost of electric lighting to the householder benefits the electricity supply undertaking. As this handbook is intended as a guide to the user, or intending user of electricity for lighting and heating purposes, there is no doubt that the non-technical but reliable information in such matters as lamps, arrangement of lights, positions of control, and so on which it contains will prove of value to the public and incidentally to the industry. It may be said that such information is contained in this little book in a concise manner, and the various points are explained in simple language, quite free from the jargon of the electrician. The question of the efficiency of incandescent lamps is clearly explained in the first chapter; from which, by the way, it might have been better policy to omit the price list of metal-filament lamps. The second chapter gives a large amount of valuable information with regard to the arrangement of lamps, the superior distribution of light obtained by a number of low, rather than by one high candle-power lamp, the amount of light required, the influence of the colour of decorations on the lighting of a room, and the suitability of various shades and reflectors. The third chapter points out the economies which may be effected by the correct use of switches; and the fourth deals with the fittings suitable for the various rooms of the house.

The rest of the handbook is devoted to the practical needs of the user of electricity. It tells him what to do and what not to do when a fuse blows; warns him against the use of ginger-beer bottle wire in cut-outs; tells him how to effect sundry small repairs and how to read his meter, and gives a number of interesting summaries of electricity accounts. There is also a good deal of information concerning the advantages and low cost of electric heating; and station engineers and contractors alike might do worse than keep a few of these little handbooks in their pockets to pass on to those prospective consumers who are afraid that electricity is both dear and dangerous.—G. B. B.

Drying Machinery and Practice. By Thos. G. Marlow. London: Crosby Lockwood & Son. Price 12s. 6d. net.

From an engineering point of view, this book is of distinct interest, giving as it does not only an insight into the art of drying, but also descriptions of the typical designs of machinery and apparatus used in drying by gravitation, absorption, condensation, evaporation and mechanical means. As the author observes, a vast field for research is opened up in connection with drying and desiccating, owing to the innumerable kinds of materials which have to be dried for commercial purposes, the varying degrees to which the extraction of moisture has to be carried, and the different mechanical appliances which are in use to carry out the work.

The author has dealt comprehensively with his subject, and there is food for thought in the fact that electricity appears to be very little used in drying practice. There is a brief reference to electrically-driven centrifugals or hydro-extractors, from which one gathers that the normal speed of the basket is 900 R.P.M., and that by the use of an automatic friction clutch between the motor and the drum the use of a heavy starter can be avoided. The motor

armature is usually mounted on a sleeve which can revolve round the central spindle, and leather-covered friction shoes attached to this sleeve fly out by centrifugal force, and gradually grip an outer ring attached to the central spindle and the drum.

There is also a reference to electric heat, which is occasionally used for drying small articles by enclosing an incandescent lamp in an oven provided with shelves to carry the articles to be dried, and a pipe to allow the moist air to escape. It would seem that the electrical engineer has failed to a considerable extent to realise the possibilities which are presented in this phase of industrial work, and Mr. Marlow's book is well worth perusal with a view to seeing whether many of the operations now carried out by other means cannot be performed electrically. It is a fact that drying machinery is a necessity in a large number of important trades, and the electrical engineer should see to it that he obtains his proportionate share of the business which is to be done.—G. B. B.

A Text-Book of Physics. By H. E. Hurst, M.A., B.Sc., and R. T. Lattey, M.A. London: Constable & Co., Ltd. 1910. Price 8s. 6d. net.

This is a volume of 640 pages including appendices and index, and according to the preface was meant to cover "primarily the preliminary examination in physics in the Oxford Natural Science School, but a certain amount of additional matter has been introduced to render the treatment more complete and more generally useful." The result is that examples have been culled from Oxford, Cambridge and London University examinations, as well as from the Military Entrance examination. The vast number of examples contained in the book adds greatly to its usefulness as a text-book for students, especially for those who may be going forward to any of these examination.

The book is divided up into sections, each of which deals with one portion of what is commonly classed as physics. Thus we have the introductory section, followed by others devoted respectively to dynamics or mechanics, heat, sound, light, magnetism, statical electricity, and current electricity. Then follows a series of test papers on general physics, some appendices and an index to conclude all—we had almost said to *crown* all.

The volume is well bound and printed in clear type, and is commendably free from the usual class of printers' errors. A more uncommon pattern appears in several cases of the type having dropped out of the forme, probably subsequent to the final correction.

The introductory section deals with measurements and measuring instruments—verniers, micrometer callipers and gauges, stop watches, and the like—and the method of using these means to attain to intelligible and accurate results.

The section dealing with "Dynamics or Mechanics" is divided into two sub-sections, which treat of kinetics and statics respectively, each of which is split up into several chapters. A curious point may be noted here. In the first two chapters fundamental formulæ—such as $s = u\,t + \frac{1}{2} f\,t^2$—are printed in bold black characters, which cause them to stand out prominently from the surrounding type. This is a praiseworthy idea, and it would be interesting to learn why it is not carried out anywhere else throughout the volume.

Thereafter Heat, Sound and Light are dealt with, each in a simple concise fashion, and the text is well illustrated by diagrams. In the photometry chapter of the latter section we are informed that "the standard of illuminating power in England is supposed to be a particular kind of candle; but it is, in practice, a lamp burning pentane, invented by Dr. A. Vernon Harcourt, which gives as much light as five standard candles." The writer has always been under the impression that the Harcourt standard was equivalent to *ten* standard candle-power.

The chapters on Reflection, Refraction and Spectroscopy are very full and well illustrated—indeed, the diagrams are a feature of the book, there being almost 100 in the section on Light alone.

Magnetism follows, and is very well treated; a very complete magnetic map of the earth on a folding plate is incorporated in this section.

Statical Electricity and Current Electricity form the subject-matter of the two following sections, and so long as the authors keep to the theoretical side, no great fault can be found with them. Chapter XIII is, however, unlucky. It deals with "Electric Lighting Circuits." We are told that, in "most large electric lighting installations . . . . the P.D. of the dynamo terminals is usually large (1,000 volts, at least)." Probably a few central-station engineers whose bus-bar volts are only half this figure would feel distinctly annoyed if their power stations were not classed as "large —— installations." On a following page an example is worked out, where a building is equipped with 60 100-volt 32-C.P. lamps, 180 100-volt, 8-C.P. lamps, and 20 motors (fans?) taking 2 amperes each at 100 volts. The total demand is got out to 16,000 watts, which, divided by 746, is equal to "21½ H.P. (nearly)," and "it would therefore be necessary to get an engine of at least 22 H.P. in order to be on the safe side"; 100 per cent. efficiency may suit for theorising, but will not do for practical work.

The special feature of the book, however, is the index, and here the great fault of the whole volume lies. As already indicated, there are seven main sections and an introduction. Each of these has independently numbered paragraphs, and in the index the main sections are indicated by reference letters—thus: D, dynamics; L, light; H, heat; S, sound; M, magnetism; E S, statical electricity; E C, current electricity. The index only gives the paragraph number and the section reference letter, neither page nor position being indicated. For example, we find "Horse-power 27 D, 47 E C, 137 E C," which translated means that horse-power is to be found in paragraph 27 dynamics, and paragraphs 47 and 137 current electricity. So far so good; but when one has to search dynamics (from page 12 to page 96) to find paragraph 27, and then to turn to the current electricity section, extending from page 470 to page 607, in order to discover the remaining paragraphs, it is easily seen how much valuable time may be lost in localising the required information. The suggested advantage of the arrangement, namely, ease of cross reference, is all a delusion and a snare. An index arranged by paragraph is always a nuisance and a trouble, but when, as in this case, the trouble is increased sevenfold, the resources of the English language fail to describe it. There is no doubt that the Editors would refuse to publish the reviewer's descriptive epithets.

As a text-book the volume should accomplish its mission, and a little touching-up to some of the chapters where there are snippety little paragraphs without any apparent connection with the context would remove any cause for complaint.

But, for any sake, write up for the book *a new index.*—J.D.M.

"UNACCOUNTED FOR."

By A. T. BULLEN.

Units generated but not accounted for; in other words, units used for some purpose or by some persons, but for what purpose or by which persons apparently seems indeterminate. This unaccounted-for column is absolutely the outstanding feature of the vast majority of the annual reports drawn up by chief engineers. And yet, why should units go astray, leaving no clear record behind them? Engineers, as a rule, seem to treat this loss in a surprisingly indifferent manner, possibly because what is mystifying to the average reader of their reports is quite clear to them.

The figures embraced under the heading "unaccounted for" are misleading, because they are in reality not an unaccountable loss; or perhaps it would be safer to say, a very large proportion of them are not actually unaccountable for. If this is the case, as it undoubtedly is, why have the heading at all? This appears to the writer as a very great weakness, but it is probably left as it is in the majority of cases to avoid intricate calculations, which would in many instances produce only approximate results.

It is the writer's aim in this short article to endeavour to show how and where this unaccounted-for loss occurs, how it may be separated out into definite amounts, which may be assigned to each and all the various causes by which they

are produced, and also, where it is possible, to show how these figures may be reduced. To attain this end, the writer has carefully studied a large number of the reports issued by various engineers, and has, as far as possible, separated out the individual losses from the total loss, thereby reducing the actual unaccounted-for loss to very small proportions. For purposes of illustration, one report, selected at random, which is more or less typical of all the others, will be utilised, and the approximate calculated values for the units lost will be given.

First of all, the sources of loss must be determined. They are five in number: (*a*) Transforming devices, whether static or rotary; (*b*) necessary meter loss, of which more details will be given later; (*c*) unnecessary meter loss, or loss due to faulty meters; (*d*) loss due to the heating of distributors; and (*e*) leakage losses.

It is difficult at first glance to say with any degree of certainty which is likely to prove the most serious, but an analysis of figures will help to a large extent to clear up this point.

By a happy coincidence, the writer has selected for consideration one of the simplest cases, namely, that of a high-tension alternating supply which is reduced by static transformers to low pressure. On this system, there are in use some 48 transformers, each of 50 KW. capacity. By first calculating the H.T. feeder loss, the average efficiency of these transformers, including the low-pressure cable loss over a period of one year, has been determined as approximately 93 per cent., which is an excellent figure, considering that the day load on the system is poor. The total quantity accounted for, exclusive of the quantity used on the arc circuits, is 2,462,000 units, which gives, roughly, 172,000 units lost in the transformers and in heating the L.T. cables.

By a very complicated process, a detailed account of which it is unnecessary to include in this article, the writer has estimated the transformer loss at 142,000 units. Briefly, this result was obtained by considering the mean day and evening loads on the transformers separately, since the efficiencies were, as a rule, much higher during the evening than during the day, and estimating the loss from the efficiency curves of the transformers as given by the makers. The difference between the last two sets of figures given above, or 30,000 units, now represents the loss by the heating of the low-pressure mains, which also includes the greater part of the loss in instruments and switchgear.

It is interesting to remember at this point, that of all transforming devices the static transformer is the most efficient, and it would be a good exercise for the mind to try and imagine to what extent the loss incurred by their use must necessarily be increased on systems where such devices as motor-generators are utilised.

The meter losses are the next to demand attention. The first, the necessary meter loss, occurs in one of two ways—namely, as a shunt current loss in watt-hour meters, or as a loss due to excess voltage supplied in ampere-hour meters. The writer has found by numerous calculations that whether watt-hour or ampere-hour meters are used, the total loss comes out at practically the same percentage of the total units recorded. Of course, in exceptional cases a perceptible difference is noticeable, as in the case of a circuit which has a very large power demand during the day, when the voltage is kept, if anything, slightly under declared pressure. In a case such as this the loss on ampere-hour meters is bound to be smaller than if watt-hour meters had been installed; but these isolated cases are very few, and it is quite safe to conclude that there is not much to choose between the two types. It is a curious point that where a supply company has, for instance, a recognised pressure of 200 volts, it invariably endeavours during the evening to maintain that pressure at from 205 to 210 volts.

In the case under consideration there are almost exactly 3,500 meters connected to the circuit, all of which are of the watt-hour type. This number is made up by a diversity of types, about 20 in all, but after a careful analysis of these, the writer has decided that 2·4 watts is a very fair value for the mean shunt loss per meter.

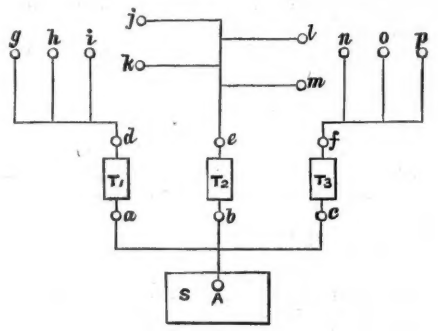
This totals for the whole of the meters nearly 74,000 units annually. In the face of this fact, it behoves chief engineers, when selecting meters for use on their respective circuits, to keep one eye fixed rigidly on the shunt losses. There is plenty of choice for them at the present time, and in glancing down a list of meters one notices that there are at least eight types of alternating current induction meters which have a shunt loss of 2 watts or under. The engineer on a direct-current system has not such a choice, since, in a list of ten continuous-current energy meters, there appears only one with a shunt loss as low as 3 watts.

Of the cable losses practically one half is accounted for in the L.T. heating loss, but investigations have shown that in our particular case the H.T. feeder losses are slightly higher. The method of calculation is again complicated, and at the best, only approximate, but the figure of 34,000 units may be safely considered as a fair value of the annual loss in these feeders, of which there are nearly 20 miles.

There remain now but two sources of loss to be considered, namely, leakage and unnecessary meter loss. These together amount to practically 6,000 units (the total loss being 286,000 units), which, considering all things, is a very satisfactory state of affairs.

It is impossible to estimate with any degree of accuracy the loss incurred by either leakage or bad meters, but for the sake of argument the writer has decided to divide them equally, so that each loss will be represented by 3,000 units annually. Since the number of consumers is roughly 2,500, the company can congratulate themselves on losing only an average of 1·2 units per consumer per annum. The writer is of the opinion that in most cases the figure would work out much higher.

Having completed the examination of one actual report, the writer will proceed in his attempt to show how, by a judicious arrangement of integrating meters, the losses may easily be examined at regular intervals. The accompanying simple diagram has been introduced to show the idea.



S is the generating station; A is the H.T. main meter; *a*, *b*, *c* are the H.T. transformer meters; *d*, *e*, *f* are the L.T. transformer meters of the transformers T_1, T_2, T_3; *g*, *h*, *i*, *j*, *k*, *l*, *m*, *n*, *o*, *p* are the consumers' meters. The total units generated are recorded by A; the total units received by the transformers are recorded by $a + b + c$; hence, $A - (a + b + c)$ is the units lost in heating the H.T. cables + any leakage that may occur. This constitutes the high-tension feeder loss.

Next $(d + e + f)$ will represent the outgoing units from the transformers, whence it is obvious the transformer loss and average efficiency can be calculated.

The sum of $(d + e + f)$, or the outgoing units, less the total registration by the consumers' meters will give the low-tension cable loss by heating and leakage, and the bad meter loss, provided that all the meters on the circuits fed from one transformer can be read on the same day.

Since it is almost safe to assume an equal L.T. and H.T. heating loss, provided the mains are distributed on practical and efficient lines, we have at once a very good idea of the state of the consumers' meters. Further, since the loss on these meters is determined by the L.T. distributor meters, we can easily trace the worst batch of meters. This would often save the meter department quite a large amount of work.

Although the diagram in this article has been purposely made simple, the writer is quite certain that the system could be indefinitely extended to suit every kind of distribution that has up to the present time been successfully employed. The initial cost would not be extremely heavy,

and although the employment of the extra meters would necessarily run up the meter loss, especially on direct-current networks, using ampere-hour meters, it is more than probable that this extra expenditure would be amply repaid in labour saved, and by the satisfaction of being able to place on record a clear and precise annual report.

Before concluding, the writer would remind his readers that the figures given must not be taken as indisputably accurate, since, as far as he is aware, there is only one H.T. meter per phase in use on the system quoted as an illustration, and none but the consumers' meters on the low-voltage side. As a result, the calculations have been necessarily rough, but can still be received as correct within reasonable limits, and may, therefore, be taken as very fair values.

PROCEEDINGS OF INSTITUTIONS.

Extra-High-Pressure Transmission Lines.

By R. Borlase Matthews and C. T. Wilkinson, Associate Members.

(*Abstract of paper read before the* Institution of Electrical Engineers, *London, January 26th; Newcastle, January 30th; and Manchester, January 31st.*)

One of the first bare overhead lines erected outside private premises, to operate at 10,000 volts in the British Isles, was installed in the Isle of Man about eight years ago, one of the present authors being associated, at that time, with the contractors who carried out the work. Since then, lines operating at even higher pressures have been put up in England, among which special attention may be drawn to the 20,000-volt overhead lines of the North-East Coast Power Supply System. The necessity for the adoption of extra-high-pressure transmission lines is emphasised in the inaugural Presidential address of Mr. S. Z. de Ferranti to this Institution. Such lines would be essential to the carrying out of the complete scheme outlined by him, if it were to be accomplished at a minimum capital cost, for underground cables would involve far too great an expenditure.

Several power supply undertakings are now operating successfully at 110,000 volts, a few 140,000-volt lines are projected, and a pressure of 200,000 volts is considered to be within the region of practicability; in fact, such a pressure is now regarded as much more practicable than was one of 100,000 volts a decade ago. Transformer manufacturers and insulator makers are considering the construction of apparatus for this abnormal pressure.

The day has now arrived when there is no engineering difficulty which will prevent the building of transmission lines of great length, but financial considerations may, from our present point of view, limit that length to about 400 miles.

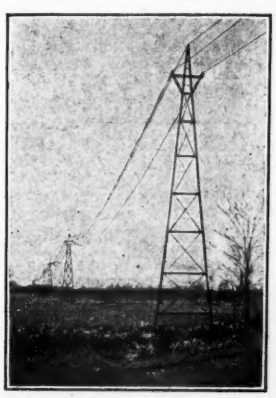


Fig. 1.—Flexible Steel Tower Transmission Line.

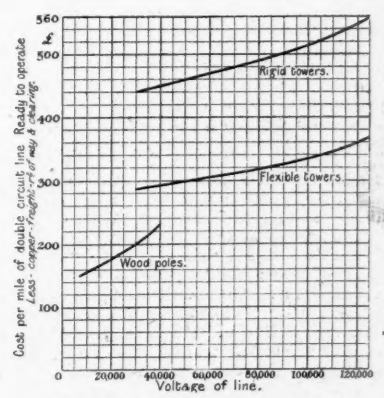


Fig. 2.—Line Cost and Voltage Curves.

Wooden pole supports for high-tension lines are now practically a thing of the past, steel structures being very much more satisfactory in every way, including prime cost. Suspension type insulators are used instead of the pin-type petticoat insulators formerly employed. This is found to be the best practice for lines whose working pressure exceeds, or may in the future exceed, 60,000 volts. Overhead ground wires are now almost universally used.

A careful study of the mechanical features of the transmission line, as a whole, led one of the authors some time ago to put up the first line of flexible steel structures in America, thus departing from the usual practice of rigid structures. An illustration of this line is given in fig. 1. This system proving very successful and economical, he then became closely associated with the installation of several other transmission lines of this type.

The authors found the flexible tower system succeed admirably in practice, and deliberate wire breakage under the worst weather conditions obtainable has shown this system to be far more reliable than that in which the four-footed rigid towers are employed. In such lines the flexible structures may be interrupted by a rigid tower at every tenth point, but experience shows that the far cheaper method of double-guying every fifth flexible structure is more satisfactory for lines using the smaller sizes of cables.

Slight bending or deflection of the tower in the direction of the line results in the shortening of the span on one side. This leads to a difference in the stresses of the wires in the different spans, resulting in a tendency for the wires themselves to act like mechanical springs, and absorb the majority of the shock produced by the breakage of the others. This redistribution of stress causes the wire to assist in a remarkable degree in the support of the towers, and prevents the development of serious distortion.

The main object in the design of these towers in this particular manner, is to provide ample strength sideways to withstand the wind stresses, and in the direction of the line, to make use of the strength of the wires themselves to assist the structures.

A matter of great importance in the design of flexible towers is the behaviour of the earth. The amount and the manner of its yield when frozen hard to a depth of several feet, as occurs in the United States, is problematical; but with the weather conditions obtaining in England, the conditions may be assumed to be roughly the same both in winter and summer. The nature of this yield, happily, is such as to assist rather than hinder the operation of the flexible tower construction. For a slight pull there is no measurable yield, but after a certain point the earth yields very readily, until a critical point is reached, after which the earth packs up and offers such resistance that the tower will break before any serious movement occurs. The slight movement obtained at first is, in many cases, sufficient to give the tower designer a very free hand in considering the flexibility of the structure.

Several standard steel and ferro-concrete poles now on the market are interesting in connection with the construction of lines of lower voltages, since they represent very fairly the characteristics of wood poles with regard to flexibility. These poles, if set at distances of from 300 to 350 ft. apart, depending upon the size and number of the wires to be carried, give a strength and price for line construction which is very favourable when compared with wood pole lines. They have the advantage over towers, in that it is frequently possible to obtain greatly reduced right-of-way charges. For a steel tower, which occupies considerable ground space, many times the price of a wood pole is frequently asked.

If a straight right-of-way is assumed, with good local transportation facilities, soft soil, and level country, with normal weather conditions, the curves shown in fig. 2 could be taken as fairly representative of the cost per mile for a given voltage. These costs are, of course, given independently of the conductor, but include the poles or towers with all the construction necessary for erecting them, the digging of the foundation holes, the placing of cross-arms, insulators and their attachment, the stringing of the wires, a single ground wire of $\frac{3}{8}$-in. steel, and, in fact, everything complete and ready for the line to operate, less the cost of conductor. It is not practicable to build a wood pole line for above about 40,000 volts for two circuits, since the length of the cross-arms becomes excessive.

A curve (fig. 3) is given of a 2,250-kw. sub-station, which shows clearly how the cost increases with an increase of voltage. While the costs of both the line and the sub-station equipments rise with the voltage, on the whole, due to the saving in expenditure on conductors and the reduction of transmission losses, the total economy of the very high-voltage system of transmission over a considerable distance is, of course, all in its favour.

While the costs given with reference to line construction are based upon American practice, it is interesting to note that the total costs for the construction of similar lines in the South of France work out at almost identically the same figures. Of course, the individual items that make up the total vary considerably.

Several types of clamps designed to hold the wire and to release it after a certain pull is reached have been evolved; but though they may operate well under test, their action on the line after they have been exposed to the weather for some time is exceedingly doubtful. This led one of the authors to design a flared sleeve wire-holder, as shown in fig. 4. The sleeve has an inside diameter two or three times greater than that of the wire it holds, thus imposing absolutely no stress on the towers in case of wire breakage. The slot underneath, with the projection immediately above it on the upper half, is provided in order that the wire may be tied in the usual way, by light tying wire, at points where a noticeable change in grade takes place. Since the adoption of these holders on one line, an unprecedented and severe flood caused the wreckage of a dead end tower. No harm, however, was done to the neighbouring towers, all the wires slipping through these sleeves and preventing any stress on the adjacent towers.

On account of the fact that insulators of the disk or suspension type (fig. 5) as compared with the pin type are easier to construct, less fragile, and can easily be made of very great mechanical strength, they are now universally adopted for high-voltage work. Those most commonly employed are designed for a working

pressure of from 18,000 to 30,000 volts per disk, and have a wet flash-over voltage in the neighbourhood of two and a quarter times this value.

In the design of these suspension insulators the fundamental principles must be kept in mind, namely, that the charging current varies with the electrostatic capacity and the resistance varies inversely with the electrostatic capacity; therefore a successful insulator should be designed to have minimum electrostatic capacity, since high resistance and low charging current are required. Several of the best known makers supply insulators guaranteed to withstand a pull of 15,000 lb. In case of wire breakage, the full suspension length is thrown into the neighbouring span, the sag of which is thereby greatly increased, which results in reduced stresses on the cross-arms.

The curve, fig. 6, illustrates the way in which the corona discharge increases with increase of electric pressure for a given wire, when all other conditions are held constant. Investigations have shown that the work of ealier investigators is only true under certain particular conditions, and that each case must be taken up separately and examined with the utmost care. It is known that the amount of discharge, *i.e.*, the loss for a given length of wire, varies with the elevation of the transmission line above sea-level —that is to say, the barometric pressure—the size of wire, the spacing of the wires, the condition of the atmosphere, the percentage of moisture, &c.

A curious effect of the sudden increase of loss after the critical voltage is reached, has been the design of high-tension lines operating at a voltage only slightly below the critical point. Any induced surges or other high-tension phenomena are thus automatically dissipated in the form of corona discharge between the wires, and the line acts as its own safety valve. Lightning trouble on such lines is therefore comparatively small, partly due to this reason and partly to the high factor of insulation employed in the apparatus operating on such systems.

When lightning trouble is experienced on lines with pin-type insulators it usually results in broken insulators, for the higher the line voltage is, the greater the tendency for the arc to hang on and rupture the insulator. This breakage of line insulators has been greatly obviated by providing an earthed metal ring round each insulator. This permits of the arc being transferred from the metal pin supporting the insulator to this ring, and thus the fracture of the petticoats of the insulator is eliminated.

The general practice on very high-voltage lines is now to do without any protective apparatus for the transformers, and instead to protect the line itself more effectively. For this purpose the overhead earth wire is now universally employed. Where lightning arresters are employed, the electrolytic type is now the accepted standard.

The weather conditions in the United States are more severe than those in England, but the usual allowance there is ½-in. thickness of ice all round the wire with a 65-mile per hour actual wind velocity occurring at the same time, or ¼-in. ice with an actual wind velocity of 77 miles per hour.

It is an interesting fact, borne out by long experience, that conductors of the same length and equally taut, will swing synchronously in any wind. Thus there is practically no danger of crossing or short circuit in the case of long spans.

The foundations of steel poles are frequently rather difficult to manage, especially if a heavy line or a large number of light lines are carried. The tendency is for a steady wind blowing on one side of the line slowly to move the poles out of the vertical, and though, if the foundations are properly made, this can never be serious, yet it greatly detracts from the appearance of the line. At corners, and also at angles in the line, this is much more liable to happen, and ample bearing surface should be provided.

Continuity of service is best maintained by building two separate lines, which should run as far as possible apart—at least 1 mile, and as much more as practicable. Experience shows that a ground wire is of undoubted value, and better results may be expected from two than from one.

A liberal factor of safety should be allowed on the insulators. This is a part of the line where it will be found profitable in the long run to spend plenty of money.

Ample spacing should be used for all high-tension transmission line wiring. A good rule which holds between 30,000 volts and 100,000 volts is 1 ft. per 10,000 volts.

Few branches of transmission work have received more careful attention than the protection of highways, railways and telephone lines at points where they are crossed by high-tension electric power lines. Perhaps the best approved methods of protection adopted in the Eastern States for railways and highways are the grounded cross-arm device, and the system which depends for its safety on very rigid mechanical specifications for the crossing span.

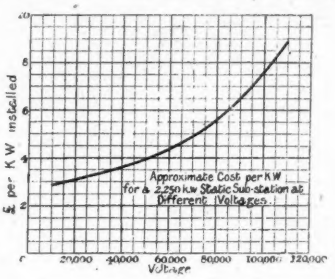


FIG. 3.—COST OF SUB-STATION AND VOLTAGE.

FIG. 4.—FLARED SLEEVE WIRE-HOLDER.

The grounded cage net for highways is found to be a source of almost as much danger as that which it should guard against. An ingenious system which has been used is illustrated in fig. 7. In this system, the span is supported immediately on either side of the railway or highway, and the spans on either side of this crossing span are of extra length. The two crossing poles carry the necessary insulators, &c., but the wire is not tied tightly to them, but is supported in such a manner that in case of breakage it will readily slip through and be pulled clear by the longer spans.

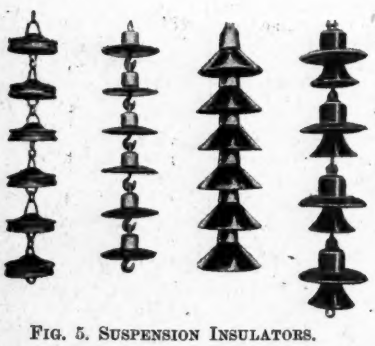


FIG. 5. SUSPENSION INSULATORS.

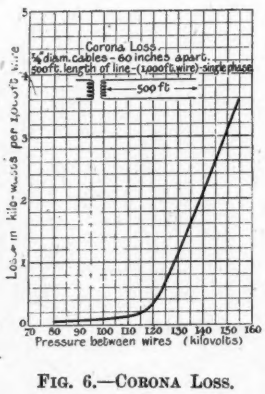


FIG. 6.—CORONA LOSS.

DISCUSSION AT MANCHESTER.

THE CHAIRMAN (MR. J. S. PECK) said Mr. Taylor's paper gave a general idea of the magnitude of the problems involved in long-distance transmission. He did not agree with some of the author's statements on capacity and inductive effects. Mr. Matthews's paper went more into the details of construction of insulators.

MR. W. CRAMP asked for further explanation on some of the points raised. Messrs. Matthews and Wilkinson stated that a pressure of 200,000 volts was now considered to be within the range of practicability. He would like to know where such a system was proposed, as Mr. Peck had given about 120,000 volts as the limit that insulators could satisfactorily withstand. In connection with this limit, the question arose whether that which was satisfactory in the United States would be so in England. Messrs. Matthews and Wilkinson stated that the poles were placed 300 ft. to 350 ft. apart, while Mr. Taylor's paper gave the limit at 750 ft

MR. A. E. MALPAS, discussing Mr. Taylor's paper, and referring to the corona discharge, said that he believed some experiments had been made on the use of a cable built up of a thin copper conductor wound round a hemp core. Split conductors had been recently adopted in the case of a large installation supplying approximately 20,000 H.P. at 60,000 volts from a point on the River Jucar to Madrid, a distance of over 300 kilometres. In this case the two sets of wires ran on the same posts; it seemed, however, preferable to run the duplicate line on independent posts for convenience of making repairs, as in the event of trouble both lines probably would have to be shut down. In the later Continental practice, the overhead ground wire did not appear to be in use. From the mechanical point of view he agreed that this ground wire would be of considerable value. The new flexible tower construction was used in the case of a transmission line supplying Madrid with 15,000 H.P. at 50,000 volts from the River Tagus, 75 kilometres away. The towers were of extremely light construction, and had proved very satisfactory in practice. The earthing device at railway crossings, he had invented himself in connection with a 5,000-volt system in Spain. This device should be largely used for crossing roads.

MR. A. P. M. FLEMING suggested the possibility of employing, on really high-voltage systems, one of the three-line conductors, suitably earthed, in place of the earthed protecting wire ordinarily supported on the highest point of the pole construction. While this arrangement would upset the symmetry of the electrostatic conditions of the three lines, and would considerably increase the stress on the insulators supporting the two insulated lines, the total increase in cost involved in using insulators of the suspension type suitable for the increase in stress would be comparatively small, and would be offset by the saving in cost and erection of the special earthed wire and the insulators on the earthed line. There did not seem to be any serious electrical objection to such an arrangement.

MR. J. FOSTER said the idea held by many engineers that high-tension transmission could never be employed in this country because of the absence of great water powers, overlooked the fact that there were other sources of cheap power. In this country 10 or 11 million tons of pig-iron were produced per annum, and with large economical gas engines the surplus of power available after

supplying all the needs of the blast furnaces was between 1,000,000 and 1,500,000 B.H.P. continuously. In addition, there was a large amount of power available from coke-oven gases.

Mr. J. Lustgarten, speaking on the effect of the corona, said that for a fixed voltage the limiting diameter of the wire could be deduced. If the electrostatic field intensity or stress at the surface of the wire were calculated, it was found that for a wire of 0·5 cm. the limiting value was 50 kilovolts per cm. The same effect was produced with either A.C. or D.C. It would eventually be found that the disruptive strength of air expressed as electric intensity would be constant, but at present there was no explanation for the different breakdown values with increasing diameter of wire. In Mr. Taylor's paper, in the section on suspension type insulators, the statement that a flat plain disk had a greater electrostatic capacity than a smaller disk with concentric petticoats on the under surface required some modification. With the same thickness of porcelain between the electrodes in the two cases, the electrostatic capacity must be the same, and the voltage at which the corona

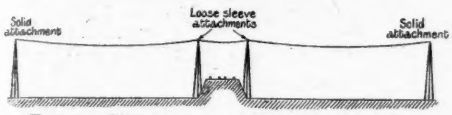


Fig. 7.—Protection of Railway Crossing.

formed on the electrodes and on the porcelain supports must also be the same. With increase of voltage the corona on the petticoated disk was forced downwards, and thus its effect as a condenser or conducting area was diminished. This action, together with an increase in the arcing distance, especially if the petticoats were long, required a greater sparking voltage than in the case of the flat plain disk.

Dr. E. W. Marchant (communicated) said that over here the question of wayleaves was fundamental, and he hoped that some information would be forthcoming on this matter. Steinmetz had shown that it was possible to adjust the line constants so that the pressure at the transmitting and receiving ends of the line should be the same. For a short line the extra capacity and inductance required to give a "wave" transmission would be too great, but it did not seem unlikely that such a scheme would be workable for such transmissions as were described in the papers. In nearly every station which he had visited in America, with the possible exception of Ogden, Utah, wooden pins were being replaced as rapidly as possible by metal pins, the trouble due to digestion of the pin by brush discharge from the thread of the screw in the insulator being most serious. Mr. Taylor stated that corona had the effect of reducing the effective resistance and increasing the line loss, but this surely was a mistake, as the production of the corona absorbed a considerable amount of power and had the same effect as increasing the line resistance. Referring to a statement in the second paper that the working of a line slightly below the critical point might act as a safety valve for lightning discharges, this was a very dangerous method of protection, because of the likelihood of "flashing over" between the lines. On a line of the Central Colorado Power Co. he had seen such a "flash over" between the lines (which were then working at 90,000 volts), due to a lightning surge or something of that kind. The factor of safety against corona effect (allowing for altitudes) on that line was about 1·34, and this "flash-over" seemed to him an indication that the factor of safety was really a little lower than was consistent with entirely satisfactory working. Small particles of dust and dirt on a line working under these conditions would produce a brush discharge, and have the effect of ionising the air, thus rendering a "flash-over" more likely. At the Great Western Power Co.'s transmission in California, which was the best design he had seen, transposition towers had been introduced about every four miles, and unless this was done, transpositions of the telephone wires themselves, whether they were on the tower or in the neighbourhood of the line, would not completely eliminate induction effects. The problem of the construction of a line which would be thoroughly reliable under all conditions, could hardly be considered to have been solved. Even at Island Bar, during the short time he spent in the station, there were two or three short circuits (occurring at some point on the transmission line) which had the effect of operating the relief valves, thus causing the surge pipe (which protected the pipe line from water hammer) to overflow. In San Francisco the stoppage of the tramcars for 10 and 20 minutes appeared a very common occurrence. There was very little doubt, of course, that as time went on, the reliability of such transmission schemes would improve.

Electric Heating as Applied to Cooking Apparatus.

(*Discussion on paper by* Mr. H. Gray *at the* Institution of Electrical Engineers, *Manchester, January 17th*, 1911.)

Mr. S. J. Watson said that notwithstanding the higher efficiency of self-contained heaters, the balance seemed to lie with the hot plate method on account of its completeness and adaptability to ordinary cooking utensils. He regarded the author's oven design as excellent. The question of heating should be approached with a view to employing electricity for every purpose where gas and coal was at present used. The first requirement was a good supply of hot water for baths and domestic uses generally, and in this direction the author's regulator should have a good future. Good regulation of heat was also an essential, especially in the case of an oven where two or three heats were required for different stages of cooking. The future seemed to call for a self-contained stove with everything water and dirt proof. It was time the various supply companies throughout the kingdom combined to settle the vexed question of suitable charges; the "telephone" system appeared to be the system of the future.

Mr. A. J. Cridge said that reference was made to an electric oven requiring 3 kw.; this figure was excessive, as he used an oven requiring only 1·5 kw. The use of a thermometer appeared academical, and not likely to be of any service. It was not altogether a question of right cooking temperature, as certain things, such as toast, required radiant heat rather than hot air. The "telephone" system of charging was good providing it was made compulsory to use electricity throughout the premises. The electrical manufacturers should have the courage of their convictions, and if they were confident of the excellence of their apparatus, let them hire it out; electrical supply authorities were sufficiently over-capitalised without engaging in hire-purchase business. The quickest cooking oven was not necessarily the best, as the quality of the cooked food depended much upon the speed of cooking. The system of hot plates at the top and bottom of the oven appeared to be far preferable to that in which the heating coils were at the side. Light ovens were also ahead of heavy lagged ovens, and in a particular case a lunch for 12 persons was cooked for 3d., against a cost of 8d. using a heavy gas-pattern electrical oven.

Mr. F. S. Grogan said he had come to the conclusion that electric cooking stood where gas did about 15 years ago. The gas people had to educate the people, and the same would have to be done regarding electric stoves. Regarding hiring of cookers, the policy of leaving this to the manufacturers was entirely wrong, because a manufacturer could only hire out at rates which would pay him on a commercial basis, and these rates would greatly exceed the 3s. par quarter charged for gas stoves. The electricity supply authority could afford to hire at a nominal rate, and allow, say ½d. extra on the price per unit, thereby getting their money back from the sale of energy. He, therefore, advocated hiring stoves at a nominal charge and keeping up the price for energy, especially in view of the fact that sooner or later new mains would be required to meet the demand and would entail a large capital outlay. Demonstrations should be given throughout the country by competent people, such efforts being backed up by both manufacturers and supply authorities. After exhaustive tests on certain apparatus, he definitely stated that, with gas at 2s. 6d. per 1,000 cb. ft. and electricity at 1d. per unit, the comparative costs for cooking were equal. The author's figures were entirely wrong. In order to make comparative tests, commercial apparatus should be used. In 1908 a Fletcher gas stove hired at 3s. per quarter was tested. The tests showed ·048d. per lb. of water at 8 ft. per hour consumption, and 0·55d. per lb. of water at 50 ft. per hour. These figures were double those given by Mr. Gray, and showed that the gas costs for a practical stove were higher than the author had found for an electrical stove—viz., ·041d. Nobody would think of putting a 5-pint kettle on to boil at 20 minutes per pint, or 1 hour 20 minutes if full. This comparison at such a slow rate of boiling was most favourable to gas. The average time was about four minutes per pint. Tests recently made had shown a 16-pint urn to give an efficiency of 80 per cent., starting from cold. The speaker strongly advocated the hot-plate method of heating. In making comparison the total power should always be given, starting from cold conditions. An electric cooker with all accessories to supplant a kitchen range should not cost more than £10 or £12. Highly polished exteriors on ovens were far preferable to lagging, and a case under test showed that an oven consuming 1,600 watts could be brought up to baking temperature in 20 minutes at a cost of about ½d. In order to show the difference between boiling water in small quantities and boiling water for baths, &c., a summary of tests had been prepared. As a basis for comparison, the following had been assumed, viz.:—

Coke at 20s. per ton would give 12,000 B.TH.U. per lb.
Gas at 2s. 6d. per thousand cb. ft. would give 685 B.TH.U. per ft.
Electricity at 1d. per unit would give 3,455 B.TH.U. per unit.

—	B.TH.U. obtainable from 1d. worth at 100 % efficiency.	For cooking purposes.		For bath and hot water supply.	
		Efficiency obtained in practice.	Useful B.TH.U. obtained.	Efficiency obtained in practice.	Useful B.TH.U. obtained.
Coke ...	112,000	2 %	2,240	66⅔ % (Ideal stove)	74,667
Gas ...	22,833	12 %	2,736	50 % (gas geyser)	11,416
Electricity	3,455	80 %	2,764	90 %	3,109

It would appear obvious from the foregoing table that although it was possible to compete favourably using electricity for cooking purposes, it was hopeless to attempt to boil water in bulk.

Mr. J. Frith, speaking from a householder's point of view, said that 1 lb. of water could be boiled in 4 minutes, using 1·2 cb. ft. of gas, and the same quantity of water could be entirely evaporated in 19 minutes, using 4·35 cb. ft. of gas. Concerning bread-making, 8 lb. of bread could be baked in 50 minutes, using 26 cb. ft. of gas. As a result of the above tests, he was satisfied that the author's figures were very nearly correct. The condition which seemed to retard the progress of electrical heating was the tremendous first cost. Reliability of the apparatus had been secured except in the case of flexible cords which were always a source of trouble. Why

not have a complete glass front to the oven instead of two small spy holes?

Mr. E. Thomas, referring to the objection raised by one speaker to the use of a thermometer, said that the past methods of cooking were very crude; the thermometer enabled the cook to regulate the heat nicely, and the small windows were particularly useful. The hot-plate system was very practical and reliable. There were conditions under which it would be economical to heat, light and cook by electricity, as in the case of a country house with suction gas plant.

Mr. T. H. Hurst said that the great feature connected with electrical cooking was the even oven temperature and avoidance of all the trouble entailed in "stoking up" with coal. Further, it was possible for a cook to handle many more utensils, hence there was an economy in labour.

Mr. J. S. Peck (chairman) said that during his recent visit to America, he saw a great many types of cooking apparatus, and was warned never to have anything to do with 200-volt apparatus, in fact, anything over 110 volts was unsatisfactory.

The Author, in reply to Mr. Watson, said that the hot-plate principle would be generally adopted if the efficiency was higher. It was unquestionably less efficient than the self-contained vessel. The lower the price of energy the better the hot-plate system became. Mr. Cridge thought the thermometer academical, but this was not so. Thermometers were being used on coal and gas ovens, as it was realised that a great saving was effected by the avoidance of door opening. Regarding hot-plate regulation, two heats were not sufficient. He was much surprised at the consumption of 8-50 ft. per hour instanced by Mr. Grogan, as 40 ft. per hour was thought to be a very large consumption for a gas oven. A glass door to an oven was not desirable, as hot grease, &c., would be liable to crack the glass. Quartz glass would be suitable if more transparent. A certain house was being built without chimneys. It had three sitting rooms, the usual offices, and four bed rooms, electrical power being used for everything. A suction-gas plant of 12½ H.P. was to be installed in conjunction with a battery, and the estimated number of units per annum was 16,000. The energy would cost less than ¼d. per unit at the terminals of the appliances, which made a running cost of less than £20 per annum. In reply to the chairman, the reliability of high-voltage apparatus, say, up to 230 volts, was quite assured nowadays. Heating of rooms by radiators cost much more than cooking by electricity.

The Detroit River Tunnel.

At the ordinary meeting of the Institution of Civil Engineers on February 7th, the paper read was "The Detroit River Tunnel, between Detroit, Michigan, and Windsor, Canada," by William J. Wilgus, M.Inst.C.E. The following is an abstract of the paper:—

The electrically-operated tunnel beneath the Detroit River for connecting the Michigan Central Railroad, in Detroit, with the Canada Southern Railway in Windsor, was successfully completed and opened for the passage of the first train on July 26th, 1910. This was four years after work had been actively commenced, and at the close of over half-a-century's striving for means of linking together the lines of railway between East and West, *viâ* the North Shore of Lake Erie. The tunnel contains two tracks, and measures about 2½ miles between summits, and 8,310 ft. from portal to portal; it has a clear headroom of 18 ft. above rail-level.

Local conditions led to the adoption of a novel method of subaqueous construction, by means of which the capital cost and hazard to human life and health were greatly reduced, and economy of operation was subserved by the lessening of the vertical ascent for trains. In this method steel tubes in pairs were built on land, launched, towed into position, and sunk into a previously-excavated trench; there they were suitably connected, adjusted to line and level, and entirely surrounded by concrete deposited under water by the "tremie" process. Later, after the concrete had hardened, the tubes were successively pumped out, and the inner ring or lining of concrete was constructed in the dry without the use of compressed air. This procedure obviated the necessity of placing the tunnel some distance below the bed of the stream, as would have been necessary with the shield method, and permitted the top of the tunnel actually to project above the river-bed to the limiting level established by the United States and Canadian Governments.

The design of the track used in the tunnel departs from the usual practice in that it dispenses with the use of ballast and thereby lends itself to economy of maintenance and to cleanliness. Especial care was taken in the interests of safety to secure sound rails, thorough drainage, suitable signalling and interlocking, and other protective features for emergency use.

The desire for the safety and comfort of employés, as well as of the travelling public, caused the adoption of electricity as a motive power within a zone of 4½ miles, of which the tunnel forms a part. The direct-current system with batteries, and the under-running type of third rail, were selected after demonstration of the economy of that system in both first cost and annual cost of operation; and also because of the promise of greater reliability in the working of a daily service that consists at the present time of 38 trains, ranging in weight from 135 to 1,800 tons each.

The completion of this improvement, costing, with contiguous work, between $10,000,000 and $15,000,000 (£2,000,000 and £3,000,000), has brought to the public greater safety, reliability, and speed of service; for the substitution of a spacious and substantial tunnel has removed the uncertainties and dangers incident to car-ferriage across a waterway encumbered in summer and autumn with a traffic of about 60,000,000 tons annually, and rendered hazardous in winter by storms and ice. It has in turn brought to the railway savings in time and cost of operation, and the prospective increase of traffic that will inevitably follow growth of public favour, and the removal of a handicap to competition for trunk-line traffic.

ELECTRICAL NOTES FROM INDIA.

[FROM OUR SPECIAL CORRESPONDENT.]

Darjeeling.—Under the able management of Mr. Robertson the hydro-electric power station continues to prosper. Extensions have been carried out and an increase of plant is under contemplation. The surrounding tea plantation managers are becoming good power customers; they have been quick to see the advantages gained from the electric drive at a cheap rate. The voltage is not an ideal one for motors, but the units required for tea factory drive are not large, and those installed are being successfully operated. Possibly due to the absence of local electrical contractors, most of the garden managers seek advice from the municipal engineer regarding their electrical wants, and frequently deal direct with home motor manufacturers.

Kurseong.—The magistrate, who is chairman of the municipality, is asking for schemes and particulars for street lighting for the town: but up to the present no definite plans have been settled upon. It is feasible to make use of some local waterfalls, but the structural work would be costly. What appears to be more practicable is to transmit power from the Darjeeling power station about 10 miles away, and incidentally to supply tea gardens *en route* with energy at a cheap rate.

It is reported that the traffic manager and the engineer of the Darjeeling Himalayan Railway have under consideration a hydro-electric scheme for energy for their workshops at Tindharia and for battery charging for lighting their trains. This narrow gauge line is a highly prosperous one and its managing agents are very enterprising; it is, therefore, possible that such a scheme is within the range of probability. At present the principal trains carry a special truck containing a high-speed paraffin engine and dynamo for lighting; but this is at best but a clumsy method, though it answers present requirements very well.

Kalamutti.—The huge new works of the Tata Iron and Steel Co. are approaching completion, and when finished should prove a very fine example of modern electric drive. Most of the motor and generator equipment is being supplied by the Lahmeyer Electrical Co. whose representative in Calcutta is Mr. H. Speyer. British manufacturers, and local Indian contractors and agents representing them, may mourn the loss of such a big order, but where keen competition and cut rates obtain the foreigner usually gets the order.

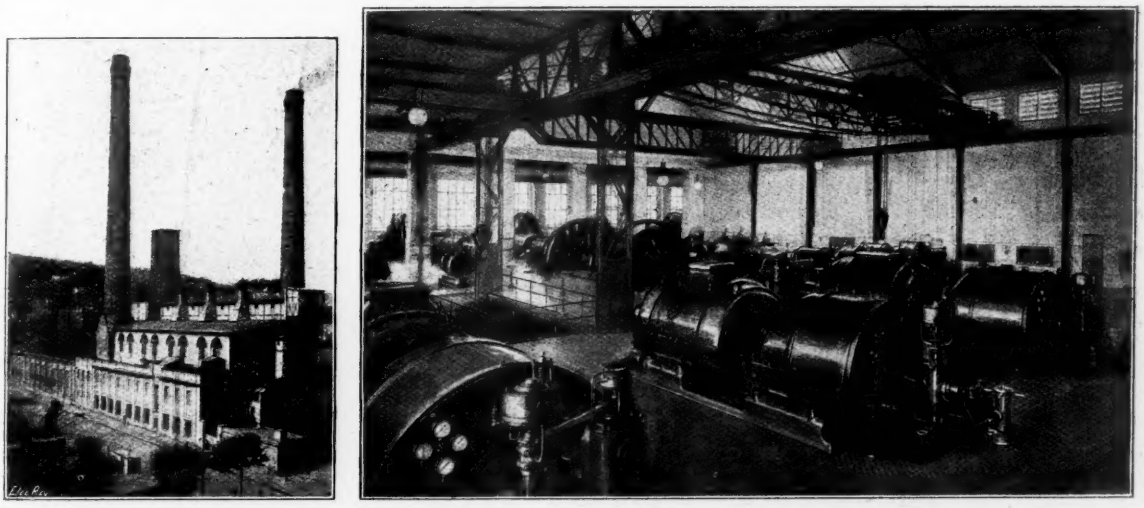
Promoting Electrical Consumption in Germany.—The Verband Deutscher Elektrotechniker recently convened a meeting in Berlin to consider the question of forming a special association for the purpose of promoting the consumption of electrical energy in every direction. After discussion the association was constituted under the title of the Geschaftsstelle fur Elektrizitats Verwertung, with Berlin as the headquarters and Mr. C. Wikander, of Schoneburg, as the director. The scope of the organisation is shown by the circumstance that the managing committee is composed of representatives of the Association of Electricity Works, the Association of Electrical Firms, the Society for the Protection of the Common Economic Interests of Electrical Engineering, the Union of Electrical Installation Firms, and the Union of German Electrical Engineers. It is intended to at once inaugurate a grand scheme of propaganda to cultivate the use of electrical energy throughout the country.

The Polytechnic (Regent Street).—The money required for the rebuilding of the Polytechnic having been privately subscribed, a large number of the old students and others who have been connected with it have heard nothing of the project. The governors, however, believing that many of these would like to have a share in the work, have decided to reserve a sum of £2,500, to be kept open until Easter for subscriptions in small amounts by them, to enable them to participate. Such subscriptions should be sent to the Secretary, 309, Regent Street, W.

ELECTRICITY SUPPLY IN BARCELONA.

So long ago as 1881 a company was formed in Barcelona to establish a central electric lighting station and for the construction of electrical plant—the Sociedad Espanola de Electricidad, which secured the concession for the lighting of a number of public streets and squares by means of arc lamps, the station also supplying energy to a large number of similar lamps in theatres, cafés, and business houses. Ten years later this continuous-current station had been supplemented by an alternating-current plant which mainly supplied current for private incandescent lighting. Each station comprised eight steam engines, of a total of about 900 H.P., which drove, either by belting or ropes, 45 continuous and alternating-current dynamos of various sizes.

A further important development in the electricity supply in Barcelona took place in 1894, when the Compania Barcelonesa de Electricidad was formed to established a large generating station for lighting and power purposes, the new concern also taking over the two existing plants. The new station, which was equipped to supply energy to an equivalent of 50,000 incandescent lamps in use at one time, was constructed by the Allgemeine Electricitäts Gesellschaft, of Berlin, to supply on the continuous-current three-wire system, and was opened in May, 1897.



Views of the Exterior and Interior of the Generating Station of the Compania Barcelonesa de Electricidad.

The generating station is located near the harbour; the original plant comprised five steam engines and dynamos, each of 1,000 H.P., a 2,000-H.P. set being added later to meet the demand which had increased owing to the completion of an electric tramway in the city. Including the battery of accumulators, the total capacity of the plant was about 8,000 H.P. The area supplied by the station was gradually increased during the subsequent years, until it extended not only to the suburbs of Barcelona, but to the little town of Badalona, 6½ miles away; and owing to the adoption of electric driving, as well as lighting, in numerous factories, the addition of a large alternating-current plant to the continuous-current station was decided upon in 1906.

This was at first arranged for a capacity of 4,500 H.P., but the steady growth in the demand for current has necessitated extensions at different times, until now the alternating-current plant has a total capacity of 19,000 H.P., the machinery comprising three 1,000-KW. steam turbines and generators, two similar sets of 3,000 KW., and a 3,600-KW. set, all of which have been supplied by the A.E.G. The extension has also necessitated the installation of an additional battery of 12 Babcock-Wilcock water-tube boilers. The alternating current is generated at 6,000 volts pressure, part being reduced to 220 volts in 35 transformer stations in the public streets and squares, and in 63 others located in various factories; the remainder is converted to continuous current at sub-stations on the outskirts of Barcelona.

A further extension of the alternating plant is at present being carried out by the A.E.G., which will bring the total capacity of the plant up to 35,000 H.P., thus rendering the Barcelona Co.'s station one of the most important in Europe. Of the accompanying illustrations, one gives a general view of the power station, and the other shows the new turbine alternating-current plant in the foreground, and the older steam engines and continuous-current machines in the rear.

Leeds Tramway Benefit Fund.—The balance standing to the credit of the Leeds City Tramways Sick Benefit Society at the end of last year was £681, plus £32 in hand for the Convalescent Home Fare Fund.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendments.

GRENADA.—An ordinance, No. 9 of 1910, has been promulgated by the Grenada Government, providing for the continuation during the year 1911 of the imposition of an additional duty of 10 per cent. of the amount of duty leviable under the ordinary tariff on goods imported into Grenada.

ITALY.—The Italian Government have recently published a decree defining that graphite brushes for dynamo-electric machines shall be dutiable at the same rate as carbon brushes for such machines. The following are the duties which have been prescribed for—

Brushes furnished with metal accessories: Dutiable as detached parts of dynamo-electric machines (25 lire per 100 kg).

Brushes without metal accessories, even if with metallic covering: Dutiable at the rate of 10 lire per 100 kg. under the head of "majolica and manufactures of coloured paste, &c., white or of a uniform colour."

AUSTRALIA.—The Australian Customs Authorities have recently issued the following decisions regarding the duty to be levied on certain electrical and similar goods. The rates given are those under the British Preferential Tariff:

Neville accumulator switch, Drake & Gorham battery regulator switch, spare parts for Thomson's recording wattmeter, excepting parts specifically named in the Tariff	Free
Electric muffle lining (a refractory silicious material similar in composition to a fireclay, and consisting chiefly of silicates of aluminium and magnesium)	25 %
"Sirocco" electrically-driven fans:	
If motors are commercially separable, motor or fan ...	20 %
Otherwise, motor together with fan	20 %
New Bosch dual ignition, a combination of magneto and battery ignition, the two being separable:	
Magneto, including the contact breaker, imported attached or in the same shipment as the magneto for which it is intended—	
If for internal-combustion engines, provided security be given, &c. (*vide* "magnetos" below)	Free
Otherwise	20 %
Ignition coil	20 %
Accumulators...	Free
Sparking plugs	20 %
Magneto parts imported in repair sets	20 %
Magnetos for internal-combustion engines, on and from November 2nd, 1910, provided security be given by the owner that they will be used only in the manufacture within the Commonwealth of internal-combustion engines, and that proof of such use be produced to the satisfaction of the collector within six months after delivery by the Customs	Free
Plugs, ebonite, coated with soft rubber, about 4 in. by 3 in., tapering to 2¼ in., used in tanks in the electrolytic refining of copper	20 %

FRANCE.—The French Government have issued a decree laying down regulations governing the temporary admission, duty free, of steel wire for the manufacture of submarine cables other than those destined to connect France with her colonies or to connect French colonies. The decree provides that the

importation of steel wire for the purpose indicated must be effected through the Customs house at Calais. The Minister of Finance is, however, empowered to open other Customs houses for such importation, if necessary. Proof, in the prescribed forms, of the conveyance of the steel wire to the factory must be forthcoming. The actual wire imported must be re-exported in the form of submarine cables within six months, and samples must be taken to prove the identity of the wire composing the cables. The import and re-export declarations must indicate the nature and diameter of the wire, the quality of the metal (tempered or not), and the breaking-strain per square millimetre of section. In support of the re-export declarations, the importers must produce certified extracts from their books, specifying the length of cable to be exported.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

1,654. "Electrical transformers." C. L. BROWN. January 23rd.

1,658. "Electric control gear." F. JACKSON and G. E. PEARSON. January 23rd.

1,662. "Power transmission clutches." J. G. P. THOMAS. January 23rd.

1,665. "Magnetic locked miners' safety lamps." R. CREMER. January 23rd. (Complete.)

1,699. "Wall box with adjustable cover for containing electrical switches and plugs and the like." J. W. BROOKS (trading as Wallsall Hardware Manufacturing Co.) and A. E. READ. January 23rd.

1,707. "Electric incandescent lamp with interchangeable carrier for the filaments." A. BLOCH. January 23rd.

1,746. "Method of producing continuous or constant electric discharges in gases." C. F. R. VON KOCH. (Convention date March 26th, 1910, Sweden.) January 23rd. (Complete.)

1,766. "Means for and method of clearing faults on high-tension alternating-current systems." A. M. TAYLOR. January 24th.

1,776. "Controllers for electrically-driven motor vehicles." H. PIEPER. (Convention dated January 25th, 1910, Belgium.) January 24th. (Complete.)

1,786. "Construction and mechanism of porcelain blocks for the wiring of electrical circuits." CALLENDER'S CABLE AND CONSTRUCTION CO., LTD., and W. LANG. January 24th.

1,804. "Magneto-electric machines employed in connection with internal combustion engines of road vehicles." G. W. DIXON and W. C. BUTLER. January 24th.

1,820. "Pole finders." M. WEERTZ. January 24th.

1,848. "Thermal-electric fire alarms." J. W. MOWBRAY. January 24th. Complete.)

1,880. "Method of hermetically sealing electrical conductors through or into hard vitreous substances." G. B. BURNSIDE. January 25th.

1,883. "Electrically-heated cooking apparatus." W. P. PERRY. January 25th.

1,884. "Thermo-electric generators." W. P. PERRY. January 25th.

1,885. "Electrically-heated ovens." W. P. PERRY. January 25th.

1,886. "Means for charging and discharging storage batteries." W. P. PERRY. January 25th.

1,900. "Thermal switch mechanism for electrically-heated appliances, particularly for kettles." G. H. COLLINS and H. F. COLLINS. January 25th. (Complete.)

1,901. "Invisible electric lock for locking and unlocking a number of doors simultaneously with an electric switch." W. NEWEY and S. T. ABRAHAMS. January 25th.

1,907. "Incandescent electric lamps." G. F. RICHARDSON and R. J. CROWLEY. January 25th.

1,909. "Electric tightening devices for cable conveyors." H. O. ADAM. Convention dated January 26th, 1910, Germany.) January 25th. (Complete.)

1,914. "Electric cut-outs." H. HIRST and F. M. CHAPMAN. January 25th.

1,930. "Electricity meter, which indicates a consumption above a certain energy." ALLGEMEINE ELECTRICITATS GES. (Convention dated February 9th, 1910, Germany.) January 25th. (Complete.)

1,942. "Polyphase alternating-current dynamo-electric machines of the commutator type." ALLGEMEINE ELEKTRICITATS GES. (Convention date, January 26th, 1910, Germany.) January 25th.

1,951. "Pocket electrical apparatus for medical purposes." P. RANSCHBURG and D. PERLUSZ. January 25th. (Complete.)

1,954. "Electric motors." J. D. ROOTS. January 25th.

2,007. "Construction of electrical elements used for transforming electricity into heat." C. R. BELLING. January 26th.

2,014. "Electric transmission of signals comprising combined numerals." SIEMENS & HALSKE AKT.-GES. (Convention date, February 9th, 1910, Germany.) January 26th. (Complete.)

2,017. "Secondary or storage batteries." A. J. BOULT. (E. W. Smith, United States.) January 26th. (Complete.)

2,120. "Signalling apparatus for use with mono or polyphase current." G. G. M. HARDINGHAM. (Hartmann & Braun Akt.-Ges., Germany). January 27th. (Complete.)

2,139. "Electric regulating rheostats." H. LEITNER. January 27th.

2,158. "Self-regulating dynamo-electric machines." A. H. MIDGLEY and C. A. VANDERVELL. January 27th.

2,168. "Combined electrical and mechanical lock for gates and the like." A. W. PENROSE. January 27th. (Complete.)

2,187. "Electrically heated brander for impressing words, names, numbers and designs." J. DUGDILL. January 28th.

2,201. "Fuse for electric lamps." H. BARTA. January 28th.

2,226. "Method and apparatus for extinguishing fires in electric cables and electric circuits, especially in telegraph, telephone and similar installations." C. GAUTSCH. January 28th. (Complete.)

2,241. "Oil cooled transformers." O. KULKA. (Convention date, February 2nd, 1910, Germany.) January 28th. (Complete.)

2,242. "Aerial conducting structures for wireless telegraphy and telephony." H. LANGE. (Convention date, February 2nd, 1910, Germany.) January 28th. (Complete.)

2,249. "Electro-magnetic relay devices." ADAMS MANUFACTURING CO., LTD. (Cutler-Hammer Manufacturing Co., United States.) (Divided Application on 7,302, 1910, March 23rd.) January 28th. (Complete.)

2,259. "Electrical time switches." J. G. MERNE. (Addition to No. 14,052, 1909.) January 28th. (Complete.)

2,279. "Plane mirror at the surface of an X-ray picture to determine the direction of any part depicted." W. COTTON. January 30th.

2,317. "Ventilation of dynamo-electric machines." SIEMENS BROS. DYNAMO WORKS, LTD., E. O. KIEFFER and M. KLOSS. (Addition to 5,118/1910.) January 30th. (Complete.)

2,323. "Method of applying a metallising liquid to electrotyping moulds and apparatus therefor." L. F. LEVY. January 30th.

2,330. "Micro-telephones." M. GRUBER. January 30th.

2,369. "Homopolar or acyclic dynamo-electric machines." O. SCHULZ and W. H. EYERMANN. January 30th. (Complete.)

2,372. "Electrically-operated pumping devices." R. F. VENNER and R. C. GRIESBACH. January 30th.

2,418. "Wire rope and electric cable combined." W. M. DUNN. January 31st.

2,420. "Combination of the electric telegraph with a typesetting machine" (such as linotype machine.) A. L. TAYLOR. January 31st.

2,434. "Magneto-electric machines." A. E. FLETCHER. January 31st. (Complete.)

2,436. "Magneto-electric machines." A. E. FLETCHER. January 31st. (Complete.)

2,449. "Device for securing wires to electrical insulators." A. NEWLANDS. January 31st.

2,450. "Primary batteries." F. RICHMOND. January 31st.

2,451. "Insulating covers for electric lamp holders." J. LOCKHART. January 31st.

2,464. "Electric primary batteries." G. FULLER. January 31st.

2,465. "Electric primary batteries." G. FULLER, G. J. A. FULLER and L. FULLER. January 31st.

2,493. "Separators and sheaths for electrodes of secondary batteries and electrolytic apparatus." V. DE KARAVODINE. January 31st.

2,501. "Telephonic apparatus." E. A. GRAHAM. January 31st. (Complete.)

2,520. "Electric lamp switches." J. A. M. TRAUS. (Convention date, February 4th, 1910, Germany.) January 31st. (Complete.)

2,530. "Relays for automatic controllers for electric motors." J. M. L. SLATER. January 31st.

2,539. "Electric thermometer for controlling and regulating hot or cold liquid either for gas or electric heaters." G. HENWOOD. January 31st.

2,552. "Device for electrically igniting miners' safety lamps." J. PRESTWICH. February 1st. (Complete.)

2,572. "Electric bell circuits." A. BALDWIN. (Divided application on 25,801 of 1910, November 7th.) February 1st. (Complete.)

2,588. "Process for manufacturing metal filaments for electric incandescent lamps." A. BOURDOS. February 1st.

2,591. "Electrical influence machines." MORRIS & LISTER, LTD., D. K. MORRIS and E. A. WATSON. February 1st.

2,594. "Electric switches." SIEMENS BROS. DYNAMO WORKS, LTD., and R. A. R. BOLTON. February 1st. (Complete.)

2,632. "Antennæ of wireless telegraphy and telephony." F. BELLINI and A. TOSI. (Convention date, February 10th, 1910, France.) February 1st. (Complete.)

2,667. "Means for packing and testing incandescent electric globes." A. A. BROWN. February 2nd.

2,686. "System for transmitting signals electrically through conductors." F. FISHER. (Convention date, February 3rd, 1910, United States.) February 2nd. (Complete.)

2,707. "Electric bulb lamp." F. RIEGER. February 2nd.

2,714. "Voltmeters." A. RUSSELL. February 2nd.

2,719. "Regulating electric tensions." H. GROB. (Convention date, February 4th, 1910, Germany.) February 2nd. (Complete.)

2,722. "Combination locks for electric switches and other serving devices." T. D. ROBINSON. February 2nd. (Complete.)

2,727. "Electric lighting system." E. M. FITZ. February 2nd. (Complete.)

2,733. "Automatic telephone exchange circuits." SIEMENS & HALSKE AKT.-GES. (Convention date, March 1st, 1910, Germany.) February 2nd. (Complete.)

2,754. "Means for generating electricity on vehicles." J. B. BELCHER. February 3rd.

2,794. "Methods of regulating the frequency of electric currents produced by rotary field generators." SIEMENS BROS. DYNAMO WORKS, LTD. (Siemens-Schuckertwerke G.m.b.H., Germany.) (Addition to 28,081/1910). February 3rd. (Complete.)

2,827. "Device for reducing the strokes of the hammer in electrically or mechanically operated machines for stopping or filling teeth." F. WINKELSTROETER. February 3rd. (Complete.)

2,841. "Self-energising telephone receiver and methods of using same." J. W. THOMPSON. February 4th.

2,845. "Switching metallic-filament incandescent electric lamps." J. W. BEAUCHAMP. February 4th.

2,846. "Instantaneous globe holder and inverted globe fitting for inverted burners and other fittings for gas, electric or paraffin lighting." W. J. BARNES. February 4th.

2,855. "Combined switch and fuse box." D. T. NEILL. February 4th.

2,887. "Electrical systems and apparatuses for railway signalling." J. P. O'DONNELL and BRITISH PNEUMATIC RAILWAY SIGNAL CO., LTD. February 4th.

2,889. "Current collectors for electrically-propelled vehicles." E. M. MUNRO and RAILLESS ELECTRIC TRACTION CO., LTD. February 4th.

2,903. "Dynamo and electric machines." O. F. SIRE. (Convention dated February 14th, 1910, France.) February 4th. (Complete.)

2,911. "Electric lighting arrangements." J. A. W. WADD and E. A. WALMSLEY. February 4th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

ELECTRICAL TRANSMISSION AND DISTRIBUTION SYSTEMS. A. F. BERRY. 23,179. October 11th.

1910.

VARIABLE-SPEED GENERATOR ELECTRIC DISTRIBUTION SYSTEMS. L. Lyndon. 649. January 10th.

ELECTROMAGNETS FOR USE IN CONNECTION WITH ELECTRICALLY CONTROLLED SIGNALLING APPARATUS, AND FOR OTHER PURPOSES. W. P. Thompson. (Morse Code Signal Co.) 671. January 11th.

SAFETY DEVICES FOR TROLLEY WIRES AND LIKE OVERHEAD ELECTRIC CONDUCTORS. B. Moore and E. Crompton. 903. January 13th.

TELEPHONE SWITCHBOARDS. W. Aitken and British Insulated and Helsby Cables, Ltd. 1,050. January 15th.